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Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

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"Once in a Long While"—

See

Saunders' Announcement

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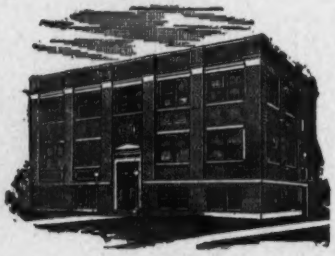

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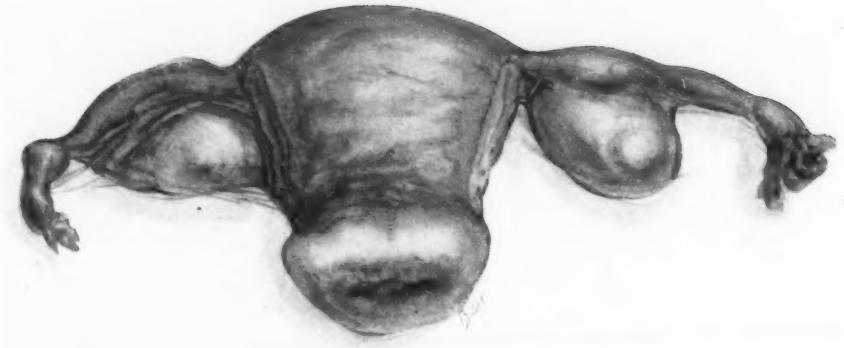

Gross specimen of tuberculosis of the cervix.—(*G. A. Moore.*)

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

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TUBERCULOSIS OF THE CERVIX UTERI

WITH REPORT OF A CASE

BY G. A. MOORE, M.D., BROCKTON, MASSACHUSETTS

SCIENTIFIC study of tubercular lesions of the female gential organs dates back about one hundred years. One of the first, if not the first, authoritative paper on this subject was published in 1831 by Raymond, a French writer, describing typical tubercular lesions. Lebert and Rokitansky, however, disagreed with Raymond and stated that it was impossible to make a diagnosis of genital tuberculosis in the living female.

Little or no further investigation was made of tuberculosis of the genital organs, judging from the literature up to 1886, when Hegar published his monograph: *Die Entstehung, Diagnose und chirurgische Behandlung der genital Tuberculose des Weibes.* This work, which has been referred to by numerous recent writers on genital tuberculosis, marks an epoch of advance and is still considered one of the great masterpieces on this subject. Tubercular involvement of the genital organs secondary to urinary tuberculosis was first described by Virchow.

Following Hegar's work, a voluminous literature has appeared on tuberculosis of the tubes, uterus, ovaries, vagina, and vulva; but comparatively little study has been given to tubercular lesions of the cervix. A result of the lack of study of this subject is reflected in modern textbooks on gynecology, the majority of which devote very little space to these lesions. And to the general practitioner, who frequently refers to textbooks for aid in diagnosis, the descriptions found of tubercular lesions of the cervix are rarely helpful and often misleading. To quote from two recent authors as examples: "The cervix is rarely infected by tuberculosis. When this does occur the infection is usually primary. The appearance is that of an irregular ulceration." "Tuberculosis of the cervix usually appears as a caseous ulcerating process, but in some cases forms a hyperplastic vegetating outgrowth, which resembles a venereal wart or early papillary carcinoma."

The chief reason for the apparent general lack of interest in this subject is the invulnerability of the cervix to invasion by the tubercle bacilli. Williams states that, except for the vulva, the cervix is found involved with a tubercular infection in fewer cases than any organ in the female genital apparatus. The stratified pavement epithelium with which the vaginal portion of the cervix is covered, probably offers a strong barrier to infection, and the tenacious secretion from the cervical canal with which the cervix is constantly bathed has been proved by Menge to be very strongly bactericidal. This author injected various pathogenic organisms into the cervical canal and twelve hours later found the secretions from the cervix sterile. Stengal makes note of the

SMB

fact that tubercle bacilli have never been found in vaginal secretions. In cases of tubercular involvement of the peritoneum and uterus, Merletti was able to obtain tubercle bacilli from the cervix by cannula when they could not be found in the discharge from the cervix.

While tuberculosis of the cervix is very rare indeed, undoubtedly many cases have been diagnosed early cancer, syphilis, etc., without histological study. There is no doubt that many cases of early cancer of the cervix, diagnosed from the clinical symptoms, which have recovered spontaneously or after conservative operations, were tuberculous.

Spaeth reported 6 cases of tuberculosis of the cervix. Zweigbaum, in 1888, reported 29 cases, 3 being primary. Beyea, in 1901, reported 69 cases, 2 being positively primary and 9 others probably primary infections. In 1902, Williams stated that 133 cases had been reported in the literature. Primary cases had been reported by Friedlander, Veit, Emmanuel, Kaufmann and others. Since that time many other cases have been reported as a result of routine histological study of specimens removed for diagnosis or at operation. Among these reports undoubted primary infections of the cervix have been reported by Lewers, 1902; Croft, 1902; Brook, 1903; Kynoch, 1903; Young, 1907; Horrocks, 1908; and Vineberg, 1908.

It can be readily seen from the foregoing statements that primary tuberculosis of the cervix is an extremely rare disease. Probably not more than 15 or 20 cases have been reported. As primary infections, we should include only those cases in which the cervix is the only organ involved. Where other distant organs are involved it is impossible to rule out an hæmatogenous infection even though infection by an external route seems plausible.

Of the secondary tubercular infections of the cervix, probably about 150 have been reported. This probably represents only a small percentage of all cases as undoubtedly many have passed by unsuspected or have been diagnosed cancer, syphilis, etc. Veyrat states that in 2 per cent of all cases of pulmonary tuberculosis in men the patients have tubercular infections of some part of the genito-urinary system. This percentage probably would apply to women. Eden and Lockyer found the cervix affected in about 8 per cent of all cases of tuberculosis of the female generative organs. Williams found at Johns Hopkins Hospital that one out of every twelve operations for removal of the tubes and ovaries for inflammatory disease was due to tuberculosis. He further stated that 75 per cent of all cases of genital tuberculosis would have passed by unnoticed in 137 operations except for routine microscopical examinations at the same hospital. From his experience he is certain that 75 per cent of all cases of genital tuberculosis are unnoticed by the general surgeon. Comparing the figures of Veyrat, Eden and Lockyer, and Williams, we find that about one-sixth or one-fifth of one per cent of all pulmonary tubercular cases in women have tuberculosis of the cervix.

The portal of entry to the bacilli in the secondary cases as well as in the primary still offers a wide field for study. Veyrat states that tubercle bacilli probably are carried by the blood stream in genital affections more often than by any other means. In experiments carried out by Lafforgue, tubercle bacilli were obtained from the blood stream in two inoculated guinea pigs. Out of 89 cases of tuberculosis of the cervix reported by Veyrat, 38 had pulmonary tuberculosis. This is a much higher percentage of pulmonary involvement, as a cause of infection of the cervix, than most investigators have found. These figures probably can be discounted somewhat as Veyrat does not state how many cases had an involvement of other genital or urinary organs.

The next most common route of infection of the cervix is by direct extension of a tubercular process from the tubes, ovaries, or uterus, or by secretion from these organs passing over the cervical mucosa.

In connection with this subject the mode of infection of the generative organs is of interest; not only in the secondary cases but in the true primary cases as well. In cases where an active process in the lungs cannot be demonstrated, a healed or dormant process

cannot be ruled out as the focus from which the process in the genital organs originated. Undoubtedly many cases of genital tuberculosis arise by direct extension from some process in the intestines or urinary apparatus. This is probably a reason for the frequency of tuberculosis of the tubes. According to Hegar, 10 per cent of all tubal infections are tubercular. Fraenkel was the first to call attention to the fact that the cervix may be involved in a tubercular process secondary to the tubes and the uterus be free. The same observation has been made by several other writers. In many other cases the uterus has been found involved co-incidently with a process in the cervix. These facts prove conclusively the incorrectness of Rokitansky's statement that the internal os is a barrier to descending or ascending tubercular infections. Of less frequency as a focus of infection of the generative organs are the foci in bones, joints, etc.

External means as a method of infection of the genital organs have been a subject of much interest to investigators of these lesions. The most frequent method by which bacilli are brought in contact with the female genitalia from external sources is by coitus. The other means are by handling with unclean hands and the use of unclean gloves, hands, or instruments in making examinations. The latter are doubtless far less frequent causes than coitus. Infection from external sources is undoubtedly the cause of primary lesions of the cervix, and a large number of tubercular lesions in the other genital organs can be attributed to it.

In coitus bacilli are brought in contact with the female genitals in two ways: first by handling the genitals before coitus with hands soiled with tubercle bacilli or by the use of sputum for a lubricant from a person with pulmonary tuberculosis. Hegar, Spæth and others state that infection is frequently borne in this way. Hammer[1] cites a case of a husband with pulmonary tuberculosis who used his sputum for lubrication at coitus. His sputum contained tubercle bacilli. His wife became infected and at autopsy tubercular tubes were found.

[1] Ztschr. f. Heilk., xxi, new series.

Veyrat and Pozzi assert that inoculation with tuberculosis may occur by simple contact without erosion or solution of continuity of the cervical mucosa. Curt-Jani found tubercle bacilli in the epithelium of the epididymis tubules of patients with phthisis. The testicles were not diseased. He also showed that tubercle bacilli would pass through normal capillary membranes. These conclusions were confirmed by Veigert and Gartner. Several other investigators have found tubercle bacilli in healthy testes of patients dying from phthisis. We may conclude that tubercle bacilli may pass through healthy organs in the genital tract in patients with phthisis without causing any pathologic change, just as patients with tubercular cervical adenitis may have no demonstrable lesion in the tonsils or lungs.

The fact that after passing into or through the healthy genital organs, tubercle bacilli are carried by the spermatic fluid must be accepted, to borrow a legal phrase, on circumstantial evidence alone. This applies also to cases in which the genital organs in man are the seat of a tubercular process. Although much careful search has been made, tubercle bacilli have never been demonstrated in the semen. Cornil, Fernet and Derveille, Curt-Jani, Schuckart, Laudouzy and Martin, Gartner and others have shown that bacilli may be carried by the spermatic fluid. Derveille proved in five women with genital tuberculosis that the husband of each had tubercular epididymitis. Martin cited by Jannin[1], reports a case of tubercular salpingitis ocurring six weeks after marriage to a tubercular patient. Pfannenstiel, Prochownick, Kelly and Merletti have reported cases of genital tuberculosis in women whose husbands were suffering with tuberculosis of the testes. Stengel, however, states that women with genital tuberculosis have husbands in most cases with pulmonary tuberculosis but no infections of the genitals. It would seem that there is sufficient evidence in the literature to prove that coitus is the cause of many cases of genital tuberculosis in women. We have no statistics to show how many cases of tubercular lesions of the cervix are due to

[1] Lyon méd., 1904, 457.

some lesion in the husband. Probably all of the primary cases can be attributed to this cause and doubtless a large percentage of the secondary cases.

There are four different varieties of lesions of the cervix commonly mentioned, and two others that occur in very rare instances. These are classified according to their anatomical and microscopical forms: (1) miliary, (2) interstitial, (3) vegetating, (4) ulcerating; the rare forms are (5) catarrhal form of Schutt, (6) inflammatory form of Cotté. In the majority of cases all types begin in the cervical canal, only occasionally on the vaginal portion of the cervix. In the later stages all types of lesions develop into the ulcerative form resulting in a purulent vaginal discharge and more or less hæmorrhage.

1. *Miliary form.* This is a rare form. Beyea states that only two cases had been reported before 1901, one by Virchow, the other by Cornil. According to Kynoch, the miliary type of lesion is an early stage of ulceration. Tubercular granulations more or less extensive are to be seen on the cervix. These do not differ from the miliary type of lesion found in other organs. The background is red, tubercles protrude, some are small, running together, some are isolated. Some are half transparent, others yellow. This type is frequently associated with miliary tuberculosis in other parts of the body.

2. *Interstitial form.* Veyrat states that this type of infection is almost impossible to diagnose clinically. The whole cervix may be enlarged and patulous or small and conical shaped with a small orifice. In the true interstitial type, there are no lesions of the mucosa; the infected areas, usually in the form of tubercles, are within the muscle bundles or surrounded by connective tissue in the stroma. In the later stages the tubercles break through the mucosa forming ulcers, the epithelium becomes thickened resembling carcinoma. Frequently malignancy occurs coincidentally with tuberculosis.

3. *Vegetating form.* This is also called the proliferating or papillary type by many authors. The process begins in the cervical endometrium, especially the lower portion, and may extend to the vaginal portion of the cervix. In the early stages there is a hyperplasia of the mucosa later developing into fungous masses of pink color. In some cases they become sessile attaining the size of cherries. In rare cases they obstruct the canal causing pyometra. They are soft and friable, bleeding readily on palpation, resembling the papillary form of carcinoma for which this type of lesion is frequently mistaken. Their soft, velvety feel, however, is a distinguishing characteristic. Like the two preceding types, these vegetations often become necrotic, forming ulcers.

4. *Ulcerating form.* This is the most common type and, as has been mentioned, is a late stage of the first three forms in many cases. In others, ulcers may be found in conjunction with other types of lesions. The ulceration is usually the most prominent lesion. Murphy stated that the ulcers seemed to commence near the external os, spreading over the vaginal portion of the cervix and up the canal. The ulcers may be large and single or small and multiple tending to coalesce. There is a complete loss of substance, the borders of the ulcers are clear cut or punched out with a tendency to phagedenism. They are usually covered with necrotic material, which on being removed, reveals whitish yellow or grayish bases. The floor of the ulcers is soft and there is an absence of marked induration and friability which distinguishes this type of lesion from squamous-celled carcinoma. The cervix is usually hypertrophied and the os patulous. Frequently there is a spreading of the ulceration to the vagina. During the later stages there may be a complete destruction and excavation of the cervical canal and the vaginal portion of the cervix about the os. Veyrat describes a form which resembles an endometritis of the neck of the uterus to which are added tubercular nodules. The nodules coalesce, the mucosa becomes infiltrated and undergoes caseous degeneration becoming granular and yellowish throughout, liquefaction ensues and on removing the detritus, the ulceration appears. These lesions at times invade the muscular bed.

5. *Catarrhal form of Schutt.* This is a

rare form localized histologically in the superficial epithelium and glands of the neck. On examination, the appearance is not dissimilar to a simple endocervicitis. In the case of Schutt which has served as a basis for diagnosis in later cases, the lumina of the glands of the neck were filled with grayish masses, the epithelium of the glands was detached in places and in the submucous and muscular layers about the vessels there was an infiltration of round cells. The diagnosis was made on finding numerous bacilli on section.

6. Inflammatory form of Cotté, paratubercular lesion. The existence of histological tubercular lesions would not be necessary to make a diagnosis of this type. This form is based upon a case in which the glands were hyperplastic with sclerosis of the rest of the neck. In no section was histological tubercular formation found. The relative frequency of the different types of lesions is given by Chaton,[1] in a study of seventy-seven cases: ulcerating form 37, proliferating or vegetating 22, miliary 7, ulcerating and proliferating 6, ulcerating and miliary 5.

The microscopic appearance of tuberculosis of the cervix depends upon the stage of the disease and the type of lesion. Tubercular follicles may be isolated or confluent in different stages of evolution, accompanied by an intense inflammation. The process is often found extending along the course of the vessels, with involvement of the deep intermuscular tissues causing necrosis of muscle bundles. The glands often undergo hyperplastic changes, the cells becoming enlarged and the secretions abundant. Tubercular infiltration may develop in the interglandular spaces, blocking up the neighboring glands so that they appear as solid columns of cells. Retrogression changes finally occur, resulting in necrosis and caseation. Giant cells are rarely found in the glands proper. During the earlier stages the glands may become papillary, polypoid or dendritic, resembling carcinoma or, as Emmanuel says, the glands and stroma may hypertrophy resembling adenoma. The malphigian epithelium covering the vaginal portion of the cervix may present zones of necrosis and neighboring zones of hyperplasia. Papillæ develop, interpapillary prolongations of epithelium burrow into adjacent tissue appearing malignant. Alterthum stated that he found not only a degeneration and proliferation of epithelial cells but a concentric disposition of cells resembling cancerous pearls. Diagnosis in such cases is very difficult, in view of the fact that in a certain number of cases tuberculosis and cancer have co-existed in the same case.

Miliary form. Characteristic giant cells are found in connective tissue which is infiltrated with round cells. Beneath the cervical epithelium are muscle bundles surrounding small islands of embryonic connective tissue in the center of which are giant cells and epithelioid cells. These frequently follow the course of the vessels.

Interstitial form. The microscopic anatomy is not very definite. Calcified sections show muscular fibers, then a zone of embryonic cells and then a zone completely necrosed. The embryonic cells tend to form rounded nodules within which are giant cells.

Vegetating or papillary form. Some cases begin as tubercular catarrhal endocervicitis extending to gland structures causing hypertrophy and hyperplasia of gland cells. In other cases the gland cells are little changed, the tubercular process being limited to the stroma tissue.

Ulcerative form. Microscopically this form is never found alone. In the submucous tissue or even in the muscular fibers in the region of the lesion, there is a cellular infiltration in which tubercles are located and which always extends farther than the dimensions of the ulcer would lead one to suppose. The glands and papules are sometimes covered with two or three thicknesses of epithelium. The glands are numerous, irregular, dilated, and filled in some cases with leucocytes. The epithelial proliferation does not invade the interglandular tissue as in epithelioma where the membranes of the glands are broken.

The subjective symptoms of tuberculosis of the cervix are rather vague and indefinite. Since in the majority of cases there is

[1]Rev. de gynéc., 1908, 947.

involvement of the uterus, tubes or ovaries, symptoms, when present, are frequently referable to these organs. Malaise, indefinite pains in the lower abdomen, a sense of weight in the pelvis and sacral backache are occasionally complained of according to Beyea. In most cases the general condition is good, failing health is rarely seen except in patients with an active process elsewhere in the body. Fever is a rare symptom. Amenorrhœa, which has been considered by some observers as a constant symptom, was found by Murphy in 28 cases to occur in but 12. In 3 the catamenia was normal and in 13 profuse. The most common symptom is leucorrhœa. In the early stages the discharge is slight, mucopurulent and inoffensive. During the later stages, as ulceration increases, the discharge becomes profuse, purulent, and very offensive. In rare cases it is tinged with blood. Slight bleeding after coitus is a fairly frequent occurrence and this is what brings the patient to examination. In the very late stages there may be considerable blood in the discharge, but this differs from the watery blood-stained discharge of carcinoma as it is purulent and offensive.

Clinically the diagnosis is in all cases difficult. All types and stages of the disease resemble carcinoma. Of 56 cases reported by Beyea, 14 were diagnosed cancer. Pean said tuberculosis of the cervix has all the objective symptoms of carcinoma. The history is important, showing the chronic nature of the disease and often tuberculosis elsewhere in the body. Age is important in differentiating tubercular lesions from cancer of the cervix. Tuberculosis occurs most frequently during the period of sexual activity, while cancer occurs in patients past middle life. In an analysis of 57 patients, Beyea found 6 to be between seventeen and twenty-six years; 27 between twenty-one and thirty; 9 between thirty-one and forty; 5 between forty-one and fifty; 5 between fifty-one and sixty; 3 between sixty-one and seventy, and 3 between seventy-one and seventy-nine.

The appearance of the discharge is important. In the early stages it is glairy mucus, later becoming frank pus or streaked with blood, especially after coitus or examination. This differs markedly from the blood-stained serum of carcinoma.

Pain which is a characteristic symptom of carcinoma, as has been mentioned, is slight and indefinite in tuberculosis. The general condition of the patient is important. In cancer there is a progressive loss of weight and strength with the advance of the growth. Tuberculosis of the cervix may exist a long time with but slight constitutional symptoms unless an active process exists elsewhere in the body.

On examination the appearance of the cervix is an aid to diagnosis though not characteristic. As the disease begins in many cases in the canal and extends downward, the cervix becomes enlarged and patulous admitting the examining finger. The diseased tissues are soft and velvety to the touch, not as friable as carcinoma, bleeding slightly on manipulation; much less than in malignancy. Infiltration and induration of surrounding tissues is usually slight. Beyea states that in some cases there is more than in epithelioma of the vaginal portion of the cervix, but never as much as in adenocarcinoma. In the advanced cases mobility of the uterus on examination is against carcinoma as is enlargement of the tubes. The frequency of involvement of the tubes in cervical tuberculosis has already been mentioned.

Simple erosion of the cervix and cervical herpes are to be distinguished. Herpes usually occurs in multiple lesions, circular with red bases unless they are secondarily infected. Primary lesions, soft sores, ulcers and gummata often resemble tuberculosis but are usually readily diagnosed by the Wassermann test.

There is such close similarity to cancer in nearly every form of tuberculosis of the cervix that a specimen for microscopical study should be taken in every case. And owing to the similarity in microscopical appearance it will be necessary to resort to guinea-pig inoculations and the von Pirquet test in certain cases. The co-existence of carcinoma and tuberculosis which has been reported by several authors should not be forgotten.

The treatment should be directed toward a

complete eradication of the disease. Medicine and hygienic treatment are of little avail. Two methods, conservative and radical, are advocated. The conservative method, amputation of the cervix preferably with a cautery or cauterization of infected areas in the cervix followed by the application of caustics, such as zinc chloride or caustic potash or antiseptics is advised by Hegar, Fauré, Murphy, Martin, Beyea and others. The curette should be avoided owing to the danger of disseminating the infection. The radical method of treatment, panhysterectomy, by the abdominal or vaginal route is indorsed by Pozzi, Lewers, Emmanuel, Frank, Kynoch and others.

In the choice of a method of treatment each case must be considered individually. Pozzi's advice "that given a case of circumscribed ulceration of the cervix without tuberculosis elsewhere, we should have no hesitation in doing a panhysterectomy," should be accepted with reservations. The question of depriving a woman of the possibility of childbearing must be considered. Professor Tedenat, cited by Martin, reported a case of a primary tubercular lesion of the cervix treated by cauterization, after which the patient became pregnant and gave birth to a living child. On the other hand the employment of conservative methods of treatment when the cervix is extensively involved, reserving radical treatment for recurrence of the process, is a questionable procedure. Cornil, Veyrat, Martin and many others have shown histologically that the macroscopic involvement of the cervical canal or the vaginal portion of the cervix is not an indication of the extent of the process. Many cases, which show only a slight external lesion, on section of the cervix, are found to have an extension of the process deep among the muscle bundles. As will be shown by the report of my case, enlargement of the tubes and uterus does not exist in all cases where these organs are involved.

Beyea's report of fifteen cases treated surgically gives us some idea of the results to be expected following the different methods of treatment. In ten cases panhysterectomy was done; in one the uterus was curetted, the cervix amputated and a double salpingo-oophorectomy done; in four the cervix was amputated. Three of the patients upon whom pan-hysterectomy was done died from shock, phthysis, or tubercular peritonitis; of the remaining seven, six were well five and one-half years after operation. The patient who was curetted, whose cervix was amputated and upon whom salpingo-oophorectomy was done, recovered. The other four are not mentioned. He also reported eleven patients treated with local applications; one was said to have recovered, five were temporarily relieved and in five the disease progressed. Murphy stated that in cases where the cervix alone is involved, amputation of the cervix is sufficient. As the mortality from panhysterectomy is 30 per cent, he warns against this method except in rare instances. He advises curetting and cauterizing with 30 per cent zinc chloride for thirty-six hours, and if the disease returns, excision of the involved area. The danger of this procedure would seem to be that a recurrence of a tubercular process often indicates an extension to other structures.

The final decision of the method of treatment in a given case should be made only after a careful consideration first of the patient's general condition. If there is an active process elsewhere in the body, excision of the local process will be of no benefit. Second, the question of childbearing must be given consideration in certain cases. If the patient desires to have children and the general physical condition will permit it, a conservative operation should be done, provided the uterus and tubes are not extensively involved. If, for any reason, the question of childbearing is not be be considered, panhysterectomy should be done whenever there is reason to believe that the uterus or tubes are involved. There are certain cases in which the tubercular lesion in other parts of the body is healed or dormant and the lesion in the cervix is progressing, when a conservative or even a radical operation may be indicated. This can be decided only after careful study.

The prognosis depends entirely upon whether there are active lesions in other parts of the body and on the complete eradi-

cation of the local process. In cases with pulmonary involvement with a secondary involvement of the cervix the prognosis is always grave. Where the process is definitely localized in the cervix, simple amputation gives good results; or if localized in the generative organs alone panhysterectory will effect a cure. But if there is extension to the vaginal walls or the pelvic peritoneum, panhysterectomy followed by local applications offers little hope of cure.

The following is a report of the author's case.

Mrs. S., age 27, Milwaukee, Wisconsin, June 12, 1916. Referred by Dr. Pulsifer, Whitman, Massachusetts. The family history is unimportant. There is no tuberculosis in the family. The husband is living and well. Late history and examination of husband revealed nothing abnormal. The patient has been married 8 years, has no children, and has never been pregnant. She has had the diseases of childhood, otherwise has always been well. Her appetite has been excellent, bowels normal, no urinary symptoms. Catamenia has been regular, and normal in amount. There has been no dysmenorrhœa.

For the past four weeks the patient has been having an occasional slight vaginal hæmorrhage which also has been noticed regularly after coitus. She has had no pain in the abdomen or pelvis nor sense of discomfort, nor has she had any pain on coitus. She has lost no weight or strength, and her general health is excellent. She comes for examination only on account of hæmorrhage.

Physical examination shows a well developed and nourished, rather fat woman. Her general condition is excellent. The pupils are equal and react normally. The skin has a good color. Her teeth are in good condition. Her throat is normal. The lungs are normal on percussion and auscultation, she has no râles. Her heart is normal. Blood pressure 124. The abdomen is full, tympanitic throughout, with no masses or tenderness. The extremities are normal. The reflexes are normal. Vaginal examination shows that the perineum is normal, and the vaginal walls are apparently normal. The cervix is moderately large, soft and patulous, the os admits the examining finger. About the os, especially on the posterior side, there is a nodular feel. The examining finger is found slightly stained with blood. On examination with a speculum there is found to be a region about one-half inch in width about the os which is bright red in color, with a small ulcer on the posterior side. In the wall of the visible portion of the canal are a few small grayish and yellow nodules or large papules. The uterus is normal in size, freely movable; the adnexa are normal, the urine is normal.

In view of the short history a diagnosis of early epithelioma was made and a specimen removed from the posterior lip with a tonsil punch and sent to Dr. F. B. Mallory at the Boston City Hospital. The following is his report:

"June 15, 1916: Examination of specimens from cervix, S–16–1027, shows tuberculosis."

The frequency of tubal involvement in all genital tuberculosis influenced the decision in favor of panhysterectomy. On July 3, 1916, vaginal hysterectomy was done by the writer after the usual technique, applying Doyen clamps to the broad ligaments and leaving a small part of the left ovary *in situ*. Clamps were removed 48 hours after operation. Convalescence was good and the patient was discharged from the hospital, July 16, 1916.

Report on specimen removed at operation. By F. B. Mallory, Department of Pathology, Harvard Medical School, August 17, 1916:

"Microscopic examination of the uterus and appendages, M724, shows tuberculosis of the tubes, fundus of the uterus, and cervix. The process is oldest in the tubes where there is caseation in addition to giant-cell formation and an accumulation of many endothelial cells. In the uterus and cervix, the process is limited to the mucosa and consists of the formation of fairly numerous miliary tubercles. The underlying muscle tissue is not involved in the slighest."

This was doubtless the miliary type of lesion with early ulceration.

Th patient was last seen October 18, 1917. Her health was excellent, but she was complaining of a very foul leucorrhæa. Abdominal examination was negative. Vaginal examination revealed considerable induration of the vault of the vagina but no ulceration. Apparently there was a recurrence of the tubercular process.

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CHOICE OF METHOD IN OPERATIONS UPON THE PITUITARY BODY[1]

BY CHARLES H. FRAZIER, M.D., SC.D., F.A.C.S., PHILADELPHIA

DURING the past ten years, partly as a result of investigative inquiry into the physiological properties of the pituitary body, partly, and to a greater measure, as a result of the direct observations of the anatomical lesions on the operating table in the living subject, the practical problems of pituitary disease have been illuminated. There is no longer the uncertainty that once prevailed as to the management of these cases, and there is slowly evolving some sort of order out of the earlier period of chaos. While to be sure the surgery of the pituitary body is still in its developmental stage, we now have at hand an abundance of facts, physiological, pathological and clinical, which serve as a foundation upon which the surgeon may construct his therapeusis.

The life history of the pituitary tumor is a matter of no small significance. Let me remind you that in its pathological deviations the pituitary is not unlike the thyroid gland. As with the thyroid so with the pituitary the most common lesion is the adenoma, in both instances often with cystic developments. It is within the limits of a reasonable estimate to say that 75 per cent of pituitary tumors may be classified as adenomata. In fact the more minutely specimens are examined and the greater the experience of the examiner, the smaller is the percentage of malignant growths. While pituitary lesions at best present many grave aspects, the absolute benignity of the underlying process in the majority of instances detracts somewhat from an otherwise serious situation. In other words, if means can be devised to prevent the recurrence of local or general intracranial pressure, the life and comfort of the patient may be assured for many years.

As a result of our larger and longer experience in dealing with pituitary disorders we have been able to formulate with greater precision the conditions under which surgical therapy is to be recommended. The symptoms of pituitary disorders which must be reckoned with are: (1) those due to general intracranial pressure, such as headache; (2) those due to involvement of the optic chiasm and tract—the ocular phenomena; (3) those due to involvement of neighborhood structures; and (4) those due to secretory derangement. As yet I have had no cases under my care where justification for the risks entailed in operation were furnished by the secretory disorders, such as acromegaly or the Froehlich syndrome, or by neighborhood symptoms, so that in large measure the surgeon is asked to intervene for one of two conditions, either distressing headache or vomiting, or failing vision, and in the final analysis it is threatened vision which, in the mind of the patient, provides the imperative demand for relief. Unfortunately, in the majority of

[1] This article was prepared and presented to the Surgical section of the American Medical Association at its annual meeting in 1917. On account of the general upheaval of affairs, incident to the war, the article has been overlooked. My views with regard to the choice of method have not changed since that time. On the contrary they have been fortified by a number of recurrences I have seen in patients who have been operated upon by the endo-nasal route. Furthermore these views have received confirmation by othe experience of other surgeons who since my article was prepared have advocated in their published reports the trans-frontal route.

Fig. 1. Two limbs of the incision are concealed, one by the eyebrow, the other within the hair-line.

patients who have consulted me optic atrophy is already so far advanced that restoration of vision is out of the question.

With these introductory remarks we are prepared to discuss the main issue of this paper, the choice of method in the approach to the pituitary. While numerous routes have been utilized with the same object in view, some of them through the cranium, other through the facial architecture, time and experience have eliminated all but two — the submucous septal approach (Hirsch-Cushing) and the author's fronto-orbital method. It seems to me the fundamental principles upon which is constructed the method of approach to any organ or gland, are: first, safety and practicability; second, amplitude of exposure; and third, end-results. With these basic principles as a guide, let us analyze the individual merits of these two radically different and distinct methods of approach to the sella turcica, and first with regard to safety. In a series of various methods collected by Cope[1] the mortality of the submucous septal method was estimated at 9 per cent and the fronto-orbital at 8.6 per

Fig. 2. The primary incision outlines the flap, with the base in the temporal region.

Fig. 3. The incision completed. Hæmorrhage is controlled by placing a series of hæmostats on the galea and rolling back the margins of the wound. The half turn in the wound margin absolutely controls bleeding. The relation of the bone flap to the frontal sinus is shown in *a*.

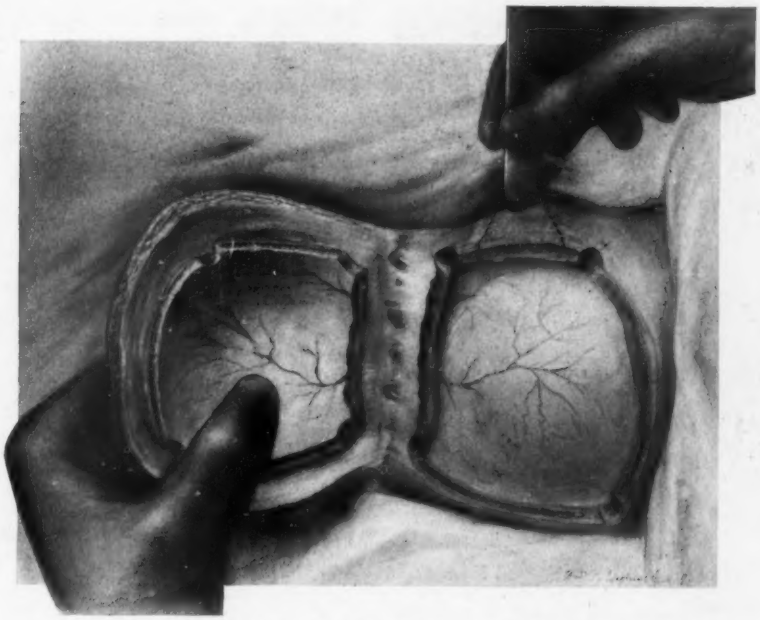

Fig. 4. The osteoplastic flap is reflected. The dotted lines represent the lines through which the supra-orbital ridge and part of the roof of the orbit are resected.

cent. Adding to this collection 8 unreported fronto-orbital operations without a death, the mortality of this method is reduced to 6.4 per cent. If I add to this series one case in which this method was used for the removal of a tumor of the optic nerve causing pituitary symptoms, the mortality rate is raised to 9.6 per cent. It is quite evident, therefore, that from the standpoint of mortality rate the two methods of approach compare favorably with one another. I believe, however, that in the course of time, as the surgeon becomes more familiar with the various steps of the operation, the cranial method will prove to be the safer, if only for one reason. By the endonasal route meningitis must always be reckoned with, and as a matter of fact has been responsible for the majority of fatal cases. One can never have the assurance, in the endonasal route, that the sphenoid sinuses are, even in healthy subjects, free from contaminating organisms. Two of the three deaths in my clinic following the endonasal operation were due to meningitis. In the fronto-orbital operation the approach to the sella may be made without invading a contaminated field, provided one avoid the frontal sinus; and in this cranial approach to the sella turcica the surgeon has no more concern about meningitis, as a complication, than he has in the exploration of any other cranial structure by the osteoplastic method. There have been no fatalities in my clinic for operations upon pituitary lesions by this frontal method, and one death in the attempted removal of an orbital nerve tumor, which, though causing pituitary disorders, was distinctly an extrasellar lesion. In this case a furious hæmorrhage occurred which was attributed to the rupture of the internal carotid artery, the walls of which had been eroded by the tumor. When the intracranial pressure was relieved the wall of the artery gave way. The details of this, the only fatal case in my series, are mentioned because the outcome reflects in no way upon the merits of the operation and could not be charged to any technical step peculiar to the operation.

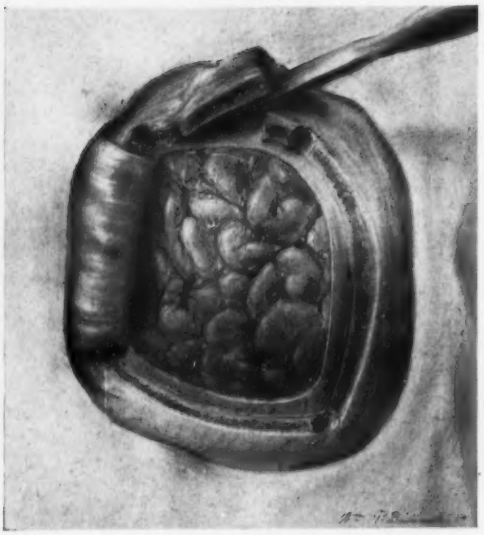

Fig. 5. After sectioning the supra-orbital ridge with a Hey's saw the fragment is removed and wrapped in gauze until the intracranial procedure has been completed.

Fig. 6. The dural flap is reflected, traction sutures are introduced on either side of a vertical incision in the dura from the anterior margins of the opening toward the optic foramen.

Viewed from the standpoint of what I have called "practicability," in the light of the surgeon's training the fronto-orbital method is the natural choice. The endonasal technique involves manœuvres entirely foreign to the surgeon's experience. From beginning to end the field of operation is cramped, one must depend altogether upon artificial illumination, and at no time has one what might be called a satisfactory view. It is quite natural that it should fall to the lot of a nasal specialist, Hirsch, to originate the endonasal method. Accustomed as he is to the technique of submucous nasal resection and to operations upon the sphenoidal sinuses, it was but one step farther to remove the roof of the sinus and open the sella turcica.

Continuing our analysis of these two operative plans, cranial and nasal, let us consider them from the viewpoint of "amplitude of exposure." There is no doubt that when the pituitary lesion is primarily and exclusively intrasellar and at the time of operation has not extended beyond its bounds, the lesion may be dealt with satisfactorily by the nasal approach. In this category, for example, would be many cases of acromegaly, where the sella turcica is more or less uniformly increased in all its dimensions, depending somewhat upon the size and shape of the underlying sphenoidal sinus. But few if any operations are performed for acromegaly alone. The principal indication is the involvement of the optic tracts or chiasm, and this in many instances implies an extrasellar extension. In other words, a pituitary lesion entirely intrasellar is not sufficient to cause optic atrophy and certainly not the signs of increased intracranial tension. The presence of either of these bespeaks usually an extrasellar extension, and to my mind this should be recognized as a strong argument in favor of the frontal approach. I have had an opportunity, on successive occasions, of comparing the advantages of inspection of a pituitary lesion from the endonasal and fronto-orbital approaches. In one of these the symptoms of pituitary disorder were unmistakable: the accession in weight, increase in size of hands and feet, spacing of the teeth in the inferior maxilla, sexual impotence,

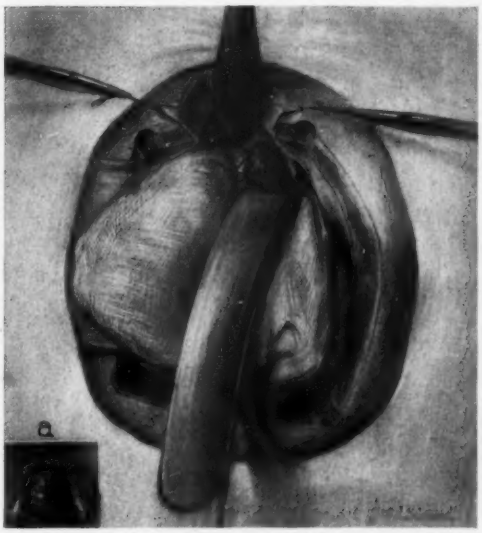

Fig. 7. The contents of the orbit are displaced downward, the frontal lobe protected with gauze is elevated and the pituitary tumor , *b*, is freely exposed between the optic tracts, *a* and *c*.

Fig. 8. The tumor is being dislodged with a curette.

well-defined changes in the eye grounds, and a roentgenogram rather characteristic of an intrasellar growth. At the operation by the endonasal method a strawberry-like mass protruded once the sellar floor was removed. When, however, its fragmentary removal was begun constant oozing prevented a satisfactory view, and on the whole it was quite impossible to estimate the size and extent of the lesion. Following a period of relief of two years' duration there was a return of visual deterioration, and the patient presented himself again for treatment. At this time I exposed the sella by the frontal method, and the readiness with which the contents of the sella could be seen and the ease with which the adenoma was removed were in striking contrast to the only too imperfect view of the first operation. It was a convincing demonstration of the relative merits of the two operations.

In this discussion the question comes to mind at once, is it possible before the operation to determine the extent of the lesion. Were this possible, let us admit, for the sake of argument, the advantage of the endonasal route for lesions strictly confined to the sella. As a matter of fact, however, it is impossible in many instances to determine by roentgenogram or symptoms how far the lesion may have extended beyond the sella or whether it ever began there. While there are pretty definite lines of distinction in the roentgenogram between a primarily intrasellar and an extrasellar lesion, there are many exceptions. I can recall in my own series, for example, the case of a man aged 61 years, who had symptoms of hyperfunction of the anterior lobe. The clinical picture was typical, the X-ray findings characteristic of an intrasellar lesion. Had I chosen in this case to approach the lesion by the endonasal route I would have overlooked altogether an endothelioma, the size of a plum, taking its origin from structures in front of the pituitary. This tumor was unquestionably the primary lesion, the symptoms of pituitary disorder secondary. Other examples of extrasellar lesions discovered only at operation by the frontal method, I might cite to emphasize this point. Even though we exclude these strictly extrasellar lesions and confine our consideration to primarily intrasellar lesions, is it possible, except by conjecture or speculation, to say

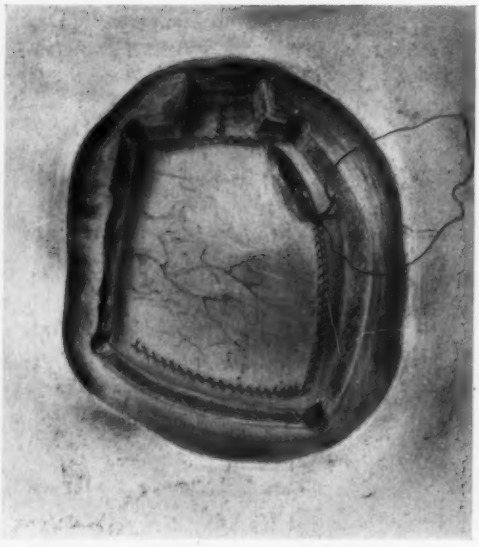

Fig. 9. The closure of the dural incisions.

Fig. 10. The fragment, including the supra-orbital ridge, has been secured in place with four catgut sutures. The wedge-shape of the fragment and the oblique direction of the bone section prevent its displacement inward or downward.

before the operation whether the lesions extend beyond the limitations of the sella? In most instances this question may be answered in the affirmative. Cope (loc. cit.) says "it seems certain that every case with visual symptoms must have considerable intracranial extension of the growth. I have searched the literature of pituitary operations fairly thoroughly and have not yet found a case with optic symptoms in which verification at operation or autopsy was permitted, which did not show a large intracranial extension. We conclude, therefore, that all pituitary tumors which come to operation for symptoms other than acromegaly have long before burst the bounds of the fossa." This is a very sweeping statement, but making allowances for certain exceptions it remains a strong argument for the cranial plan of operation, since by the nasal route only a portion of the growth is accessible.

Still another factor which should influence us in the choice of methods is the condition of the sphenoid sinus. By the endonasal method the improvement which follows is in part due to the relief of pressure. When the sphenoid sinus is large and not encroached upon, the opportunity for expansion of the lesion relieves at once upward pressure upon the optic tracts or chiasm. The roentgenogram will show before the operation to what extent the sphenoid sinus is encroached upon, and if largely or entirely obliterated, one may be reasonably sure that the results of the intrasellar approach will be of short duration.

Let us view this question now from a rather smaller angle. I have in mind the management of pituitary cysts. About 10 per cent of adenomata develop cysts. These cysts may extend well beyond the confines of the sella. In one of my own series, for example, the cyst extended 4 to 5 centimeters above the level of the pituitary and its dimensions could only be determined by an intracranial operation. Mere evacuation by puncture is of only transitory benefit. These cysts soon fill up again no matter by what method the cyst is approached. Many instances have been recorded of this sequence of events. Hence it is encumbent upon the operator,

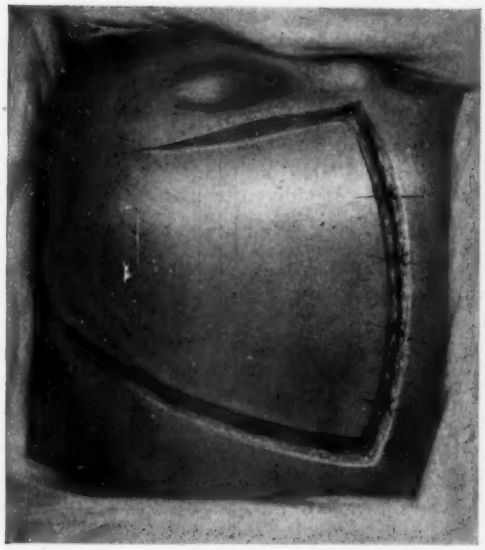

Fig. 11. The flap is replaced and the initial sutures through the aponeurotic layer are in place.

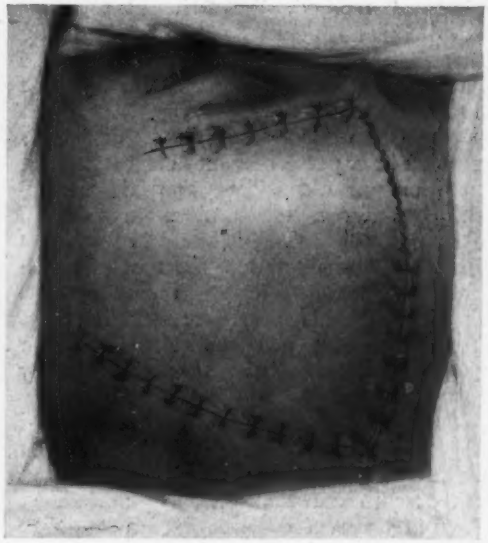

Fig. 12. The final closure of the cutaneous margin with interrupted sutures, with the exception of that portion of the incision between the root of the nose and the hair-line which is more carefully approximated with a No. 00 silk continuous epidermal suture.

should he anticipate more than transitory results, to remove a portion of the cyst wall, and this can be done effectively only by such exposure of the cyst as one would obtain by the direct suprasellar approach. Curiously enough the first case upon which the fronto-orbital route was employed in my clinic happened to be a pituitary cyst. A young man in his twenty-third year, for a least five years prior to his entrance to my clinic, had symptoms of pituitary derangement, but it was not until he began to have signs of increased intracranial pressure and was almost blind that he traveled across the Continent for relief. The cyst was really an intracranial affair and wholly beyond the limitations of an operation designed for an intrasellar lesion.

There is another restriction to the endonasal method that should be mentioned, namely, the undeveloped sinuses in children. When the sinuses are of the presphenoidal type, the adoption of this method would be hardly justifiable.

The last and third test by which I have attempted to weigh the relative merits of the two procedures under discussion is the end-results. This in time should be the acid test of all operative procedures, but in this field of surgery sufficient time has not elapsed to apply it. Case reports have not included end-results, and the records of recurrences and the records of improvement after operation in months or years are not available in sufficient numbers to enable one to make accurate and reliable deductions. To be sure, recurrence of symptoms, no matter what the method, will be frequent and necessarily so because the contents of the sella cannot be emptied completely, for obvious reasons.

Furthermore, comparison is difficult because of the wide dissimilarity between individual cases; some of them are at a comparatively early stage in the history of the lesion, others in the terminal stage with large extrasellar extensions, some adenomata, others carcinomata or sarcomata, some of them primarily intrasellar, others primarily extrasellar. To quote from another's opinion of the advantages of the fronto-orbital over the

endonasal method, the writer says, that though it is not possible yet to decide finally between these, the opinion can be expressed that the fronto-orbital route is more suitable in the majority of cases.

With this we will conclude the discussion and refer briefly to the essential features of the operation under consideration. The fronto-orbital route, a modification in turn of McArthur's operation, is the successor of a number of cranial routes, the first of which through the temporal fossa we owe to Horsley, who performed his operation as early as 1904. From that time on a number of plans for reaching the sella were proposed, mostly transphenoidal, such as the plans of Schloffer, Cushing, Hirsch, Kanavel, Halstead and others, but in 1912 an effort was made to find a safe and reasonable route, an aseptic route, resulting in the fronto-orbital method. When first proposed, it involved a reflection of an osteoplastic flap from the frontal region, the temporary resection of the supra-orbital ridge, the removal of what remained of the roof of the orbit. With the head in the Rose position, the orbital contents were displaced downward, the frontal lobe elevated until the optic nerve was exposed as it emerged from the optic foramen. The sella contents were brought into view by a horizontal incision in the dura a centimeter above the base of the skull. As originally described[1] the operation gave a somewhat restricted view of the sella contents and since than I have modified the technique to overcome this possible objection.

[1] Ann. Surg., 1913, Feb.

The essential difference between the two methods is that in the original, the approach to the sella was extradural, whereas as now practiced, the approach is intradural. This modification introduces a T-shaped incision in the dura with its horizontal limb on a level with the supra-orbital ridge and the vertical limb extending down toward the sella turcica. By this slight change in technique the frontal lobe is elevated with greater facility and the view of the sella region very much more satisfactory. Furthermore, the intradural route avoids the necessity of removing the roof of the orbit, a rather tedious step in the original technique. Certain modifications of the osteoplastic flap have been proposed by others to avoid the necessity of the mid-forehead incision, but the cosmetic results in my own series, following closure of the wound with epidermal suture, have been so good and the advantages of reflecting the flap toward the temporal region are such that I hesitate to change.

In the constructive period of any field of surgery, the pendulum of opinon swings from one view to another. My first introduction to pituitary surgery was through the frontal route. Later a number of my cases were operated upon by the transsphenoidal method, but its limitations soon became apparent and I returned with certain revisions to my original technique. The surgeon dealing with pituitary lesions should be familiar with both methods, but as time goes on I believe the fronto-orbital route will be found to have a wider field of application.

THE SURGICAL TREATMENT AND PROGNOSIS OF EMPYEMA FOLLOWING LAGRIPPE

By L. LEYVA
Medicin Aide Major, First Class
AND
DR. LEGENDRE
Medicin Aide Major, First Class

DURING the past year we have had the opportunity of treating in our service 27 patients suffering from empyema, the empyema in all but one case following la grippe. Of the 27 patients, 8 died and 19 were cured or are recovering. The mortality percentage is, therefore, a little more than 30 per cent, which is very high. How can we interpret this fact? When the patients arrived at the surgical service they were all suffering from dyspnœa and could be grouped into two classes: first those who were suffering from what might be called white dyspnœa and those suffering with blue dyspnœa. In the first group respirations were from 25 to 30 per minute, the volume depending on the amount of pleural pus. The patients were pale. The micro-organisms producing the pleurisy were the following: 9, streptococci; 3, staphylococci; 5, pneumonia. In all of the cases, operation relieved the dyspnœa and the temperature became normal within a few days.

In patients with blue dyspnœa the number of respirations was high, from 45 to 50 a minute, and there was cyanosis of the face and extremities. In these patients the dyspnœa did not vary according to the amount of fluid in the pleural cavity; as a rule the empyema was not extensive. This is not the case in the usual pulmonary diseases (pneumonia, splenopneumonia, bronchopneumonia), where there is congestion or œdema very often of both lungs. In these patients the operation did not produce a change in temperature and the dyspnœa was even aggravated, due to the artificial pneumothorax, a factor which surely helps to lessen hæmostasis which is already very deficient owing to the pulmonary condition. These patients died from 24 to 48 hours after operation. Their pleural symptoms appeared as follows: In Case 1, 8 days after the beginning of the grippe, with operation on the ninth day; in Case 2, 5 days after the beginning of the grippe, with operation the same day; in Case 4, 6 days after the beginning of the grippe; in Case 5, 3 days after the beginning of the grippe, with operation the same day; in Case 6, 9 days after the beginning of the grippe, with operation the same day; in Case 7, 5 days after the beginning of the grippe, with operation the same day; in Case 8, 7 days after the beginning of the grippe, no operation being done because of the poor condition of the patient; in Case 9 the date of commencement of pleural symptoms was not known, but the patient was admitted to the service on October 6 and was operated upon the next day.

The micro-organisms causing the symptoms in these cases were: 1, staphylococci; 2, pneumococci; 3, streptococci. This shows that neither the micro-organism nor the precaution of operation changed the prognosis in regard to the empyema. The prognosis is dependent upon the condition of both lungs. If the function of the lungs is already impaired owing to previous disease, operation aggravates the condition instead of relieving it. The 19 cases cured were operated upon after the pulmonary symptoms had subsided or were about cured. The 8 patients who died were operated upon while the pulmonary disturbance was present. Are we justified in saying that if we had postponed operation in our fatal cases our patients would have lived? Surely we recognize the seriousness of pulmonary disease which alone may cause death without pleural complications. We would like to say that the only chance of cure in these patients lay in postponing operation as

long as the pulmonary conditions were serious. In support of our theory we have the fact that the number of respirations is higher after operation than before. We cannot attribute this finding to operative shock as we operated upon the patients under local anæsthesia (10 to 20 cubic centimeters of 2 per cent stovaïne). The time required to do a simple pleurotomy was only 2 to 3 minutes. As we will show in describing our technique, we took every precaution to prevent pulmonary complications. Case 18, which is described below, shows the advantage of postponing operation while pulmonary symptoms are in progress.

Soldier C, age 19, arrived July 5 at the medical service of Dr. Tremoliers, with pulmonary complications, marked dyspnœa, and symptoms of pleural congestion on the right. On July 9, examination revealed dullness of the inferior lobe of the left lung, breathing without vocal fremitus, without egophony or bronchophony. Twenty-five cubic centimeters of a liquid of doubtful character were withdrawn. On July 10 dyspnœa was even greater. Four hundred and fifty cubic centimeters of fluid resembling that formerly withdrawn were evacuated. On July 12, symptoms of hepatization of the right lung were manifest and the patient spit pneumonic saliva. From July 10 to August 3, the patient was treated by aspiration and drainage and by the injection of specific serums. On August 3, 29 days after the beginning of his illness, the patient was sent to the surgical service. At that time he had what we term white dyspnœa and his pulmonary symptoms had subsided. At operation two quarts of foul-smelling pus (streptococci) were evacuated, after which the dyspnœa improved and the temperature fell to normal after three days.

It is not possible for us to state that Soldier C. would have died if he had been operated on at the beginning of his pleural symptoms while the pulmonary disturbances were still in evidence, just as it is not possible to say that our other eight patients would have been cured if we had postponed operation.

TREATMENT

From a careful examination of our cases we have arrived at certain conclusions as to the operation itself and as to postponed treatment. The first 25 cases of empyema followed the grippe. We believe that the empyema in these cases was of a special character both as to the clinical evolution and in regard to treatment. As we have stated, pleurisy is a complication of the grippe and appears at different stages of the disease. When it appears, as in Cases 1 to 9, inclusive, and in Case 24, at the beginning of the grippe, the prognosis is extremely serious. In all our cases, only one, Case 24, survived. That he lived was due to the fact that he was an American soldier, stronger than the other soldiers and not weakened by the great hardships which many of our patients had suffered due to the fact that they were boys from the last recruited class and were weakened by very hard work. It is also true that in Case 24, the right lung was in good condition.

In our opinion, the particular kind of micro-organism which causes the pleurisy, contrary to the classic opinion, has no bearing on the indications for operation and on the method of performing it.

We have used the operative technique as practiced by Marion, Picquet, Legara, and Charles Lemonant. We have resected the ninth rib sixteen times, the eighth rib three times, the tenth rib once and two ribs once, the eighth and ninth. We have had no complications, and postmortem examination of our fatal cases has shown that drainage was effected in the correct place. Cure in 18 cases is also proof of the advantage of such resection. We have found it advantageous to make a posterior or backward incision as has been recommended by Walter and Pringle. After operation the patient can lie upon his back without pain or inconvenience. Our experience leads us to doubt the advantages of the Hutton technique as recommended by DaCosta. Hutton believes that the pleural cavity is not drained by gravity but by inspiration. He recommends cutting the sixth rib in the axillary line as he thinks at this level the lung is not so retracted and therefore the pus is more readily evacuated by inspiration.

Our technique may be described as follows: A four inch incision is made one inch below the angle of the scapula. The external extremity of the incision is at the level of this scapular angle; the internal 10 centimeters inward. We do not cut the skin exactly under the rib but a little below. After resection of the rib which is done following the classic

indications by tying the intercostal vessels, we make a very small incision into the pleura so as to let the pus run slowly. At this moment we stop the anæsthetic and, after the pleural cavity has been emptied, we enlarge the opening at the end of which we attach a compress. We break the adhesions and remove the thick pus which will blockade the drains as it is too thick to run as we have found by examination at autopsy in our fatal cases. We now cut, in a perpendicular direction in the middle of our first incision, the skin and muscles to a length of one and one-half inches so that we have a T-shaped incision, in the vertical branch of which we put the two big drains. We sew up the transverse incision and fix the drains to the skin. Besides producing better results from an esthetic point of view, the T incision, we have noticed, prevents the formation of a fistula.

We use one long and one short drainage tube. We clean the field with ether and place a large pad of cotton on the wound. It seems to us that there is no doubt that simple pleurotomy without rib resection in the treatment of empyema is insufficient. In seven cases where we followed such a method, the first four cases, 2, 4, 5, and 7, showed at postmortem examination the presence of adhesions and thick pus, impossible to eliminate by means of such a method. In these four cases we did a simple pleurotomy because the patient was unable to undergo further treatment. Cases 20, 22, and 25 were patients in good condition and the bacteriological examination showed the pneumococci as the pus-producing micro-organisms in the pleurisy. In these three cases we were obliged to resect one rib, 14 days, 8 days, and 24 days, respectively, after the first operation and it was due only to the fact that the resection afforded a larger opening that the patients owed their recovery.

POSTOPERATIVE TREATMENT

On five of our patients we have tried disinfecting the pleura by means of hypochlorite of soda solution, irrigating the empyema cavities with Dakin solution through Carrel tubes of different lengths extending in different directions, using the technique of Professor Tuffier. We have not noticed any advantage from this treatment. As a matter of fact in studying carefully our Cases 11, 13, 25, and 26, we have found that only one, Case 13, an American soldier who had a pneumococcic pleurisy, has had no complications while being treated. He stayed in the hospital 56 days in order to leave absolutely cured. Case 11, a streptococcic pleurisy, stayed in the hospital 68 days and had to be operated upon again to secure better drainage. Case 12 absolutely contra-indicates the benefits to be gained with the Carrel treatment when there is a communication between the pleura and bronchial tree. The Dakin solution was the cause of coughing and suffocation. In Case 25 we changed the irrigation 20 days after we began using it because during that period the temperature did not become normal. The patient stayed in the hospital 84 days. Case 26, the first patient upon whom we tried this treatment, has been in the hospital 139 days and had to be operated upon three times to enlarge the wound.

It is true that with such a small number of cases we are not justified in saying that this method is definitely contra-indicated in the treatment of pleurisy, but the results in using the Carrel-Dakin method cannot be compared with those obtained in treating the patients with simple drainage of the pleural cavity. On the other hand it must be said that the Carrel treatment is more difficult and requires a particularly well trained staff.

We have tried the hypertonic salt solution in two cases. The first case is not mentioned in our case reports as it was a case of pleurisy following a bullet wound. We have had very good results with irrigation with Wright's solution through Carrel tubes. In the other case, pneumococcic pleurisy, we did not secure satisfactory results.

Of the 13 cases treated by simple drainage, the patient who was cured in the shortest time was Case 10 who stayed in the hospital 44 days; Case 12 was in the hospital the longest time, 99 days. This was a case of interlobar pleurisy with bronchial communication.

In concluding we wish to emphasize the importance of the necessity of using extreme care in applying the dressings, as it is a well known fact that the pleura very easily is infected. We must avoid touching the wound with instruments that have not been thoroughly sterilized. The area surrounding the wound and the wound itself must be carefully cleansed with ether and large pads put over the drains and all held in place by a large band. The dressing must be changed once every day during the first 20 days at least. At the end of this time we begin gradually to diminish the size of the tubes, continually shortening them until there ceases to be any drainage.

We use chloroform anæsthesia in operating upon our patients. We have not had any accidents from the anæsthetic as the amount of chloroform absorbed is too small. We require but five minutes to complete the operation. Before coming to the operating room the patients are given a quarter grain of morphine. For five or six days after operation we inject artificial serum and camphorated oil.

CONCLUSIONS

1. The prognosis in empyema is not based upon the nature of the micro-organism causing the condition, but is based principally upon the condition of the lungs.

2. As pleurisy starts early with grippe, we believe it is best for the patients to treat them medically by aspiration and injection of specific sera, until the pulmonary symptoms have subsided. At this time surgical intervention has every chance of success.

3. The micro-organism causing the pleurisy has no bearing on the type of operation to be performed.

4. In pleurisy developing late in la grippe the pleurotomy opening must be large, extending backward; resection of the rib is a necessity.

5. The classic treatment consisting in drainage without irrigation is the method of choice.

NOTE. — Since this report was written we have had occasion to see nine more cases of empyema and they all confirm our experience.

We have also seen seven patients (French soldiers who were prisoners in Germany) who were operated upon by Germans and the incisions were ade in the same location and the same ribs have been resected as we have recommended.

CASE 1. B., age 43, had an attack of grippe dating from May 16. Between May 16 and 24 purulent pleurisy developed, and on May 25 the patient was admitted to the surgical service. Bacteriological examination showed staphylococci and other microbian flora. The patient was operated upon May 27, a right pleurotomy with resection of the eighth rib being performed. The pleural cavity was found to contain about 300 cubic centimeters of fetid purulent fluid. The lobes were covered with false membrane. Several Carrel drains were put in, and Dakin irrigations were administered every two hours. On May 28 there was a fetid odor from the dressing. Elimination of fetid sphacelus tissue, blackish in color. Dyspnœa increased on May 28 and on May 29 it continued to increase. There was light cyanosis. The pulse was small and irregular. The patient died at 5:30 p. m.

Autopsy. A pocket or cyst of purulent pleurisy occupied the internal posterior side of the lung and the anterior portion of its two inferior lobes. The pocket was emptied by empyesis on the level of the eighth rib. The thickened walls were lined with false whitish membranes. The emptied pocket communicated with the lung on a level with the anterior side of the inferior lobe through a small opening. The top of the lung was free from infection. In the right lung œdema and congestion of inferior lobes were present. The presence of bronchopneumonia lesions with two cavities (size of pea) was verified.

CASE 2. G., age 19, had an attack of grippe starting May 21 with purulent pleurisy developing between May 21 and 26. The patient was admitted to the surgical service on May 27. Bacteriological examination showed the pneumococcus. On May 29 a left pleurotomy was done without rib resection. Three-fourths of a quart of pus was evacuated. Cyanosis was present, dyspnœa was intense, and the pulse small. There was no improvement after operation. The patient died May 31 at 2:30 p. m.

Autopsy. The pleural cavities, right and left, were filled with greenish pus. On a level with the ninth rib, about 2 inches from the dorsal vertebræ, was seen the pleurotomy opening made two days before death. Walling-off had taken place above this opening, preventing the evacuation of pus. The entire inferior lobe of the left lung presented the usual appearance of ordinary lobar pneumonia at the moment of green hepatization. Only one-third of the lower portion of the inferior lobe of the right lung was invaded by pneumonia. Congestion and emphysema of both superior and median lobes were seen. Purulent pericarditis was present throughout the serous membrane. Greenish pus, the same as found in the pleura, was present.

CASE 3. G., age 19, had an attack of grippe on June 18 with purulent pleurisy in evidence June 19.

He was admitted to the surgical service on June 10. Bacteriological examination showed the streptococci. Operation was performed on June 20, consisting in right pleurotomy with resection of the ninth rib. Three-fourths of a quart of pus was evacuated.

Autopsy. The right pleura was completely lined with thick pus and false membrane. In the right lung total splenization had taken place from summit to base; the three lobes were welded into one. Pus was found between the lobes. Œdema and pulmonary congestion were present in the inferior lobe of the left lung.

CASE 4. F., age 19 years, had an attack of grippe dating from June 30, with purulent pleurisy developing between June 30 and July 6. He was admitted to the surgical service July 6. Bacteriological examination revealed streptococci. Operation, consisting of right pleurotomy without rib resection, was performed July 6. Following the operation the patient showed signs of asphyxia, well defined cyanosis was present, and breathing was very labored. The patient was delirious, his pulse was small and irregular. Death occurred the same day.

Autopsy. One pint of purulent liquid was found in the right pleura, the thoracic walls were lined with false membrane and thick pus. There were a few adhesions on a level with the inferior one-third. From the left pleura there was a light serous discharge. In the right lung there were adhesions between the lobes, the lung was greatly retracted, and the bronchopneumonia center was limited to one-third of the inferior lobe. In the left lung were slight adhesions with carnification of pulmonary tissues. Pericarditis: 200 grams of sero-purulent liquid found.

CASE 5. R., age 19 years, was taken ill with grippe on July 23, followed by purulent pleurisy between July 23 and 25. He was admitted to the surgical service on July 25. Bacteriological examination showed streptococci. Operation consisting in left pleurotomy with rib resection was performed July 26. After operation, which was done under local anæsthesia, the wound became locally infected. The infection spread to the iliac region, and was cauterized. The pulmonary symptoms did not improve after operation. The patient died August 11, at 5. p. m.

Autopsy. In the left pleura there were adhesions especially in the front, on the back and sides. The pleura was lined throughout with false membrane and thick pus. The right pleura presented a roughened appearance. The left lung was retracted. Carnification of the entire lung; trial by water, positive. Congestion and œdema were present in the right lung. Trial by water, negative.

CASE 6. F., age 42 years, was stricken with grippe on August 5, followed by purulent pleurisy between August 5 and 15. The patient entered the surgical service August 14. Bacteriological examination showed streptococci. On August 14, operation, consisting of left pleurotomy with rib resection of the ninth rib, was performed. The general condition of the patient was very bad. He suffered with intense dyspnœa and asphyxia. About a quart of pus was discharged. He died August 14.

Autopsy. There was a small serous discharge from the right pleura. There were adhesions between the lobes of the right lung. The left pleura was lined with thick pus and false membrane. On a level with the lower third of the left pleural cavity, a triangular pocket containing about 500 grams of serous liquid was found. Bronchopneumonia was present in the inferior lobe of the left lung.

CASE 7. B., age 19, was stricken with grippe on September 5 followed by purulent pleurisy sometime between September 15 and 20. He was admitted to the surgical service on September 20. Bacteriological examination revealed pneumococci. On September 21, right pleurotomy without rib resection, was done. Pneumococcus bacilli were found in the blood culture. The patient died October 6.

Autopsy. Purulent pleurisy. The pleural cavity was partitioned vertically on a level with the axillary line with a discharge from the anterior portion that connected with the posterior pocket only through the top of the pleura. At the front, a large quantity of pus was found while the posterior part was totally dry. The right lung was entirely hepatized. To the left was a discharge of about 8 grams of sanguineous liquid.

CASE 8. B., age 26 years, had an attack of grippe dating from September 26, with evidence of purulent pleurisy between September 26 and October 3. He was admitted to the surgical service October 7. No bacteriological examination was made. Because the patient was in such critical condition it was decided that an operation would be useless. The patient died October 8 at 8 p. m.

Autopsy. Large quantity of purulent liquid was found in both pleural cavities.

CASE 9. M., age 20 years, had been ill with grippe for an unknown length of time, purulent pleurisy manifesting itself on October 26. The patient was admitted to the surgical service on October 7. Bacteriological examination revealed the streptococci. On October 8, a right pleurotomy with resection of the ninth rib was done. On opening the pleura it was found that the right lung did not retract and that it had the consistency of cork. The patient died October 9.

Autopsy. False membranes — pneumonia at right base, bronchopneumonia of left base.

CASE 10. C. was taken ill with grippe on May 9, complicated by purulent pleurisy probably about June 5. He was admitted to the surgical service on September 2. Bacteriological examination showed streptococci. Operation consisting in rib resection (eighth) and pleurotomy was done September 3. Two large drainage tubes were inserted, but the cavity was not irrigated. On September 30 the tubes were removed. The patient left the hospital October 17, completely cured.

CASE 11. J., age 22, was taken ill with grippe

May 9, with evidences of purulent pleurisy developing about June 26. On June 28 the patient was admitted to the surgical service. Bacteriological examination revealed the streptococci. Operation, consisting in right pleurotomy with resection of the eighth and ninth ribs, was done June 29. When the pleura was opened 8 Carrel drains were inserted, leading in different directions. Irrigations were given every two hours. During the first three days there was a regular drop in temperature. On July 3 there was a rise in temperature, morning 38° evening 39°. There was no change until July 9. The patient was brought to the operating room and the cavity was drained of thick pus. The temperature dropped and the patient left the hospital, cured, on September 6.

CASE 12. M., age 19, had an attack of grippe commencing on May 3, with purulent pleurisy manifestations between September 16 and 25. The patient was admitted to the surgical service on June 26. Bacteriological examination showed the presence of streptococci. Operation, consisting in left pleurotomy with resection of the fourth rib, was done June 28. There were symptoms of left interlobar pleurisy. Vibrations of thorax in the subclavicular region diminished but did not cease. From the third space could be heard a sound of rubbing in the pleura, extending up to the sinus. Percussion on the axillary line revealed a deadened zone, very high up, in the arm pit. On June 28, two drainage tubes were inserted. The next day Dakin irrigations were attempted, causing intense paroxysms of coughing and threatening asphyxia. Irrigations were discontinued and drainage alone continued. Eight days later in the cavity which was beginning to heal was introduced gauze dipped in gomenol oil. One month later another attempt at Dakin irrigation was made with the same results as before. At the bottom of the cavity was found a small opening, communicating with a bronchial tube. On October 5, the patient left the hospital cured.

CASE 13. D., age 22, had an attack of grippe dating from March 24 with purulent pleurisy manifestations between April 17 and May 14. He was admitted to the surgical service May 4. Bacteriological examination showed pneumococci. Operation on May 5, consisting of pleurotomy of right lung with resection of the ninth rib. Four Carrel drains were placed in the pleural cavity. During the first ten days irrigations were given every two hours of Wright's hypertonic saline solution, 10 per cent. No change of temperature. Dakin solution was substituted for saline solution and a large drainage tube was placed by the side of the Carrel drains. The temperature became normal after three days. On June 25, all drainage tubes were removed and the wound was closed. There were no complications, and 20 days after operation the patient was declared completely cured.

CASE 14. J. suffered an attack of grippe dating from June 17, complicated by purulent pleurisy about August 12. The patient was admitted to the surgical service on August 14. Bacteriological examination revealed streptococci. Operation, consisting in pleurotomy of left lung with resection of ninth rib, was done August 14. Two large drainage tubes were put in. The day following the operation subcutaneous emphysema developed, extending to the left abdominal region and following the femoral vessels down to the popliteal region. On September 20, the drains were removed and on October 15 the patient left the hospital completely cured.

CASE 15. B., age 20, suffered an attack of grippe dating from June 7, with purulent pleurisy August 13. He was admitted to the surgical service August 14. Bacteriological examination revealed streptococci. Operation, consisting in left pleurotomy with resection of the ninth rib, was done August 23. Two large drains were put in. The temperature became normal 3 days after operation with only a few oscillations due to retention. The drains were removed September 25, 15 days after which the patient was declared convalescent.

CASE 16. C., age 19, suffered an attack of grippe dating from June 3, followed by purulent pleurisy developing between the 3d and 9th of July. He was admitted to the surgical service July 9. Bacteriological examination revealed staphylococci. Operation consisting in right pleurotomy with resection of the tenth rib was done July 14. An enormous empyema cavity containing about 4 quarts of pus was found. Two large drains were put in. These were removed on August 28. The patient was pronounced cured on September 23.

CASE 17. L., age 20, was taken ill with grippe sometime between June 4 and July 5, purulent pleurisy developing about July 18. He was admitted to the surgical service on July 19. Bacteriological examination showed staphylococci. Operation, consisting in left pleurotomy with resection of the eighth rib, was done July 22. Gangrenous pleurisy was found, the pus was extremely fetid. Fragments of gangrenous pleura were found. Permanganate of potash was used for irrigation. Drains were removed August 22. The patient left the hospital on September 9, cured.

CASE 18. C., age 19, suffered an attack of grippe dating from July 1, purulent pleurisy developing between the 5th and 18th of July. The patient was admitted to the hospital August 2. Bacteriological examination showed streptococci. On July 14, operation, consisting in pleurotomy of right lung with resection of the tenth rib, was done. At the medical service after pleurisy had been recognized, treatment consisting in intrapleural injections of antistreptococcus serum was given daily and the patient kept under medical treatment until August 2. August 3, pleurotomy with resection of the ninth rib was done. From the pleura exuded about 2 quarts of fetid pus with false membranes. During the first few days the cavities were washed with permanganate of potash solutions. The drain was removed September 25.

CASE 19. G., age 19, suffered an attack of grippe dating from July 8, followed by purulent pleurisy about July 15. On July 16 the patient was removed to the surgical service. Bacteriological examination revealed the staphylococci and other microbian flora. On July 17, a left pleurotomy with resection of the ninth rib was done. Two large drainage tubes were inserted. The temperature did not drop until about August 12. The drains were removed August 22. The patient left the hospital, cured, October 5.

CASE 20. V., age 31, suffered an attack of grippe about August 31, purulent pleurisy developing sometime between September 7 and 26. He was admitted to the surgical service on September 26. Bacteriological examination revealed pneumococci. On September 26, operation, consisting in pleurotomy without rib resection, was done. On October 11, the wound was again opened, a pleurotomy with resection of the ninth rib being done. After the first simple pleurotomy the temperature dropped. On October 1 it rose and on October 6 the patient's temperature averaged 40° at night. On the 11th on resection of the rib, false membranes were found, also thick pus, which could not be eliminated by a simple pleurotomy. The temperature dropped slowly; on October 12 it became normal. The patient was discharged on December 5, cured.

CASE 21. T., suffered an attack of grippe dating from August 31. Between September 20 and October 5 purulent pleurisy developed. On October 8 the patient was admitted to the surgical service. Bacteriological examination showed streptococci. On October 9, an operation, consisting in left pleurotomy and resection of the ninth rib, was done. After the operation a large flow of pus was noted. The temperature became normal October 10, and the patient improved nicely. The drains were removed October 25, and the patient was discharged November 20.

CASE 22. B., age 19, suffered an attack of grippe dating from September 3. Purulent pleurisy developed between September 5 and 29. On September 29 the patient was admitted to the surgical service. Bacteriological examination revealed pneumococci. On September 29, an operation, consisting in simple left pleurotomy, was done and on October 7, resection of the ninth rib. As the temperature did not become normal after the simple pleurotomy on October 7, the ninth rib was resected. Large fibrous clots (about a glass full) which could not pass through the incision were found. No real pus was found. The patient was discharged cured December 10.

CASE 23. R. on September 25 suffered an attack of grippe. Purulent pleurisy developed between September 25 and October 8. On October 8 the patient was admitted to the surgical service. Bacteriological examination revealed the streptococci. On October 9, operation, consisting in right pleurotomy with resection of the ninth rib, was done. October 5 an injection of antistreptococcus serum and another of antipneumococcus serum were given. October 9, operation was performed and about one quart of pus was evacuated, and two large drainage tubes were inserted. Three days later local infection developed in the wound causing a rise in temperature. Treatment: local application of Dakin compresses. October 17 temperature became normal and the patient began to convalesce.

CASE 24. K. suffered an attack of grippe dating from October 5. On October 16, symptoms of purulent pleurisy developed. The patient was admitted to the surgical service on October 17. Varied microbian flora were revealed on bacteriological examination. On October 18, an operation, consisting in left pleurotomy with resection of the ninth rib, was done. After pleurotomy about one quart of fluid of doubtful character was evacuated. Incision T shaped. Patient convalescing satisfactorily.

CASE 25. M., age 38, suffered an attack of grippe dating from November 9. Purulent pleurisy developed between December 7 and January 4. On January 7, the patient was admitted to the surgical service. Operation, January 11, consisting in left pleurotomy with resection of the ninth rib. After operation there was an immediate drop in temperature. Daily irrigations of the pleura with Dakin solution were administered. At the end of six days there was another rise in temperature persisting for 10 days. Irrigations were discontinued. The temperature became normal. The patient recovered without the formation of fistula.

CASE 26. G., age 20, did not have grippe and the time of the commencement of the purulent pleurisy symptoms was not known. On December 24 the patient was admitted to the surgical service. Pneumococci were shown by bacteriological examination. On December 24, an operation consisting in simple pleurotomy without rib resection was done, and on January 19 pleurotomy with resection of the ninth rib was done.

After the first operation one large drainage tube was inserted. The temperature was about 38° and on the night of the tenth day it became 40°. On January 19, a second operation was done consisting in resection of the ninth rib. Four Carrel drains were placed and through them every two hours Dakin irrigations were administered. On January 22, the temperature became normal. On February 1 there was a rise in temperature with oscillations. On February 14 the temperature rose to 39.8o. On February 15 the original incision was enlarged. Next to the Carrel drain was placed a large drainage tube to allow discharge of liquids. The temperature became normal March 22, and the large drainage tube was removed. The temperature rose above normal on March 29. A drainage tube was again inserted and was kept in place until April 19. The patient was declared cured on May 13.

A STUDY OF BLADDER FUNCTION[1]

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INCOMPLETE evacuation of urine from the kidneys or bladder is not infrequent and deserves more investigation[1] than has been accorded it. The present contribution is concerned with that phase of the subject which has to do with failure to empty the bladder, and the complications which result therefrom.

In 1917, Besley[2] strongly urged non-catheterization of the bladder in cases with injury to the spinal cord, and asserted that he had never seen cystitis in a patient suffering from cord injury, unless that patient had been catheterized. He stated, further, that he had never found evidence of disturbed kidney function as a result of allowing the bladder to become distended and overflow.

This expression of opinion, by one whose judgment is to be greatly respected, runs entirely counter to my experience. Whether we shall leave an ill-functioning bladder to right itself, or shall assist nature through the use of a catheter, is a problem of much importance; it concerns not only the bladder of the soldier with spinal injury, but also many other conditions, notable among which is stasis of urine after operation.

In military service we made repeated attempts to test Besley's plan, but someone unaware of our wishes always passed a catheter sooner or later. Recently, in an experimental study of this subject, rabbits have been used. These laboratory animals are, in some respects, more satisfactory than human patients, particularly because they can be sacrificed at any desired time to determine just what changes have taken place.

Material. The bladders of twenty-two male rabbits were paralyzed by cutting the spinal cord. This injury produces a bladder paralysis entirely analagous to that which occurs in soldiers consequent to gunshot injuries of the spine and cord.

The animals were housed in sanitary cages which permitted immediate drainage of voided urine. The buttocks and genitalia were kept clean through shaving, aided by bathing and application of petrolatum many times daily.

Results. Bladder paralysis was obtained in every case; to secure this a second operation was required in three instances.

Vesical distention was present in all except one rabbit which died three days after operation. The degree of distention was moderate in eight; in the other thirteen cases the bladder filled the entire lower abdominal cavity. One rabbit, without anatomical obstruction to urinary outflow, died in consequence of spontaneous rupture of the bladder (Fig. 1). Extensive vesical erosions or ulceration occurred in nine instances (Fig. 2). Hæmorrhages in the submucosa were frequent.

The *ureters* of four were not distended and those of three were doubtful, whereas fifteen were unquestionably dilated, some to an extreme degree (Fig. 3). Of the dilated ureters both were involved eight times, the left alone five times, the right alone two times.

The *kidneys* were of much interest. Of the twenty-two cases, seven were normal and fifteen pathological. The microscope revealed that seven had nephritis, and six showed notable round-cell infiltration (Fig. 6). Intense congestion with more or less hæmorrhage was frequent (Fig. 7).

Nine presented marked dilatation of the tubules, with which was often associated (in six cases) an extensive destruction of kidney substance. Despite the absence of anatomical obstruction to the outflow, the ureters dilate, the kidney pelvis distends, and the kidney swells (Fig. 3). The cut surface of such kidneys is streaked with coarse gray lines. Microscopically these gray lines prove to be veritable windrows of parenchymatous destruction, characterized by atrophy and vacuolation of

[1] The work recently reported by David is of much practical value; more of the same quality is needed. (David, V. C. Ascending urinary infection. Surg., Gynec. & Obst., 1918, xxvi, 159.)

[2] Besley, F. A. A plea for the non-catheterization of the urinary bladder in cases of gunshot wounds of the spinal column. J. Am. M. Ass., 1917, lxix, 638.

[1] From St. Luke's Hospital, Chicago. Read before the American Gynecological Society, Atlantic City, June, 1919.

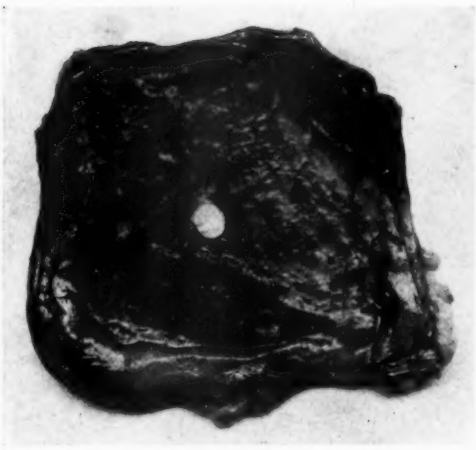

Fig. 1. Spontaneous rupture of bladder of rabbit, consequent to vesical paralysis; no urethral obstruction. The rupture was a longitudinal slit, one centimeter in length, located in the right anterior wall, near the fundus. Death from extravasaton of urine into the peritoneal cavity.

cells (Figs. 4 and 5). The specimens which revealed this destruction were all from animals with considerable ureteral dilatation. These lesions were so intense as to impress me greatly with the serious damage which results from even temporary pressure upon the delicate kidney parenchyma.

Bacteriology. Infection was evident in

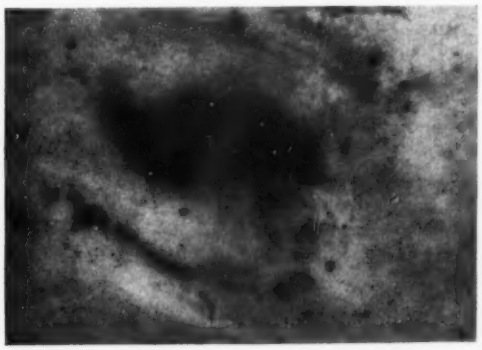

Fig. 2. Double large ulcer which developed on the anterior wall of a paralyzed, non-catheterized bladder. The floor of the ulcer was thick, gray-brown, and microscopically seen to be densely infiltrated with polynuclear leucocytes. Note numerous small erosions elsewhere throughout mucosa.

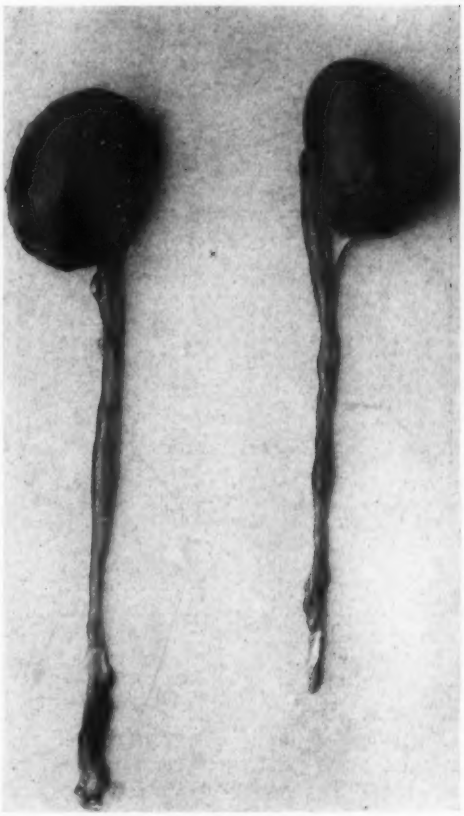

Fig. 3. Dilated ureters and greatly distended kidneys. This photograph shows what happens to the upper urinary tract when the bladder becomes overdistended and the catheter is withheld. It should be emphasized that back-pressure of urine in ureters and kidneys has been found repeatedly, notwithstanding absence of obstruction to outflow from the bladder.

twelve of the twenty-two cases. Of these, the mucosa of one ulcerated bladder was packed with polynuclear leucocytes, but bacteria were not obtained. In the other eleven infected cases many bacteria were found in smears and cultures; one of them must be excluded from consideration because there was an associated beginning peritonitis. This leaves ten cases of undoubted urinary tract infection with numerous bacteria in every instance. Infection with three types of bacteria was encountered once, double

Fig. 4. Typical destruction of kidney parenchyma which follows bladder paralysis despite absence of anatomical obstruction to urinary outflow. The result of back-pressure in ureters and kidneys.

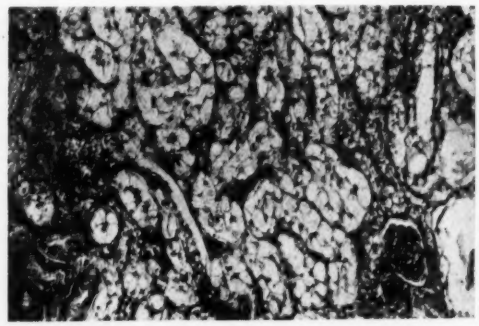

Fig. 5. Same as Figure 4, under higher magnification. No normal tissue except in extreme left of field.

infection five times, and one kind of organism four times. Bacteria were isolated as follows: colon group baccilli from six cases, staphylococci from four, streptococci three, gram positive diplococci two, gram positive short bacilli one, gram positive large bacilli one.

Summary. A study of the effects of non-catheterization of the paralyzed bladder has been made in the case of twenty-two male rabbits. Extreme distention occurred thirteen times, with spontaneous rupture of the bladder in one instance. Nine showed extensive vesical erosions or ulceration. Back-pressure with ureteral and kidney pelvis dilatation was usually present; in six cases this caused wide paths of almost complete destruction of kidney tissue. Bacterial invasion of the urinary tract was demonstrable in ten of the twenty-two animals operated upon.

These experiments upon rabbits indicate that the unrelieved paralyzed bladder offers a two-fold menace to health; first, through frequent infection of the urinary tract due to contamination of static urine; second, through back-pressure which distends the ureters, seriously interferes with kidney function and damages the kidney tissue. It would appear advisable, therefore, to maintain the paralyzed bladder in a state of freedom from residual urine, thus minimizing the danger of kidney involvement.

Post operative bladder function. Observation of surgical cases in military service has convinced me that postoperative retention in men is quite infrequent as compared with women. Given an equal number of cases of retention in men and in women, it is further probable that the latter develop a higher precentage of infections. Except in instances of bladder paralysis or obstructed outflow, the problem of vesical retention is, therefore, chiefly concerned with the female sex.

One year ago I reported a study of the female bladder during convalescence after 465 consecutive abdominal and vaginal operations.[1] It was found that especial watchfulness of the bladder is necessary after complete hysterectomy and during convalescence from prolapse operation. Paresis of the bladder for about one week frequently follows these operations, probably due to partial destruction of the inferior vesical plexus.

Catheterization of these 465 patients was performed in approximately 35 per cent of the abdominal cases, in 25 per cent of the vaginal cases, and in nearly 50 per cent of cases operated both abdominally and vaginally.

The catheter was used not only to alleviate pain, but also whenever distention of the bladder was not spontaneously relieved.

[1] Curtis, A. H. The bladder of women after operation. Am. J. Obst., 1918, lxxviii, No. 2.

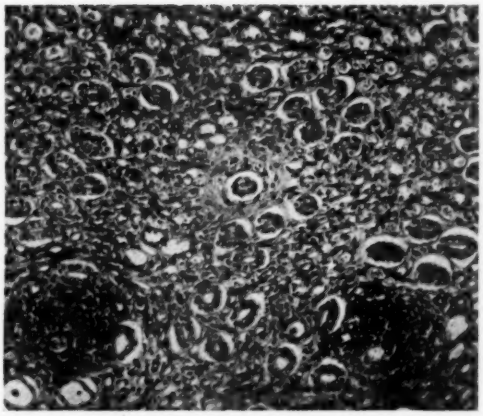

Fig. 6. Cellular infiltration in kidney cortex. An evidence that avoidance of the catheter in cases with bladder paralysis does not eliminate the danger of infection.

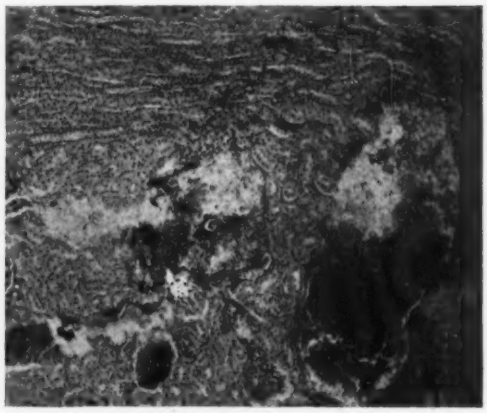

Fig. 7. Extensive kidney congestion and hæmorrhage. Another pressure injury, the result of failure to relieve the overfilled bladder.

As a prophylactic measure, a small amount of weak silver nitrate solution was instilled before withdrawal of the catheter. Most important of all, every patient who resumed the power of spontaneous micturition, after having been repeatedly catheterized, was thereafter subjected to a daily test for residual urine until this was no longer present; it is better to dispense entirely with the catheter than to use it during too short a period of time, or so irregularly that stagnant urine accumulates.

The above-outlined method of after-care of the bladder, when conscientiously adhered to, has yielded most gratifying results.

CONCLUSIONS

1. Failure to catheterize the paralysed bladder is followed (in rabbits at least) by back-pressure of urine which is exceedingly destructive to kidney tissue.

Associated urinary tract infection is frequent.

2. Irregularly performed catheterization for retention of urine is unsatisfactory. Patients so treated are subjected to such dangers as accompany the passage of the catheter and at the same time are rendered liable to accumulations of infected stagnant urine.

3. Carefully managed catheterization, of the bladder which fails to empty spontaneously, yields excellent results; the catheter should be regularly passed often enough to prevent vesical distention and its use must be persisted in until daily tests show that residual urine is no longer being retained in the bladder.

NOTES ON VESICAL DIVERTICULA; A MODIFIED TECHNIQUE OF SURGICAL ATTACK

CASE REPORT[1]

BY NATHANIEL P. RATHBUN, M.D., F.A.C.S., BROOKLYN

DIVERTICULA furnish one of the many interesting phases of bladder pathology which has been developed by the modern diagnostic methods employed in urology. Previous to the development of the cystoscope, these conditions were noted at autopsies and occasionally encountered in the course of operations performed upon the bladder for other conditions. Rarely, indeed, was it possible to make an accurate preoperative diagnosis, or to plan a definite surgical procedure which would effect a cure.

To illustrate the paucity of articles written upon this subject previous to the last decade, Young, in an exhaustive review of the literature in 1906, could find only five cases reported in which an operation had been performed for the radical cure of bladder diverticulum. To these he was able to add three cases of his own. Since that time, important contributions have been made by Chute, Cabot, Lower, Squier, Young, and others. In the past year, five cases have come under my observation. Three were subjected to radical excision by the method outlined in this paper; one declined operation at my hands and was operated upon by another Brooklyn surgeon; and one was treated by intravesical excision of the mucous lining as outlined by Young in a recent paper.

Some of the German writers early drew a sharp line between what they considered two definite types of this condition, the congenital and the acquired; the first group or true diverticula comprising those cases in which there can be demonstrated in the wall of the diverticulum all the coats of the bladder; the second group consisting of those cases whose walls were formed by mucous membrane only which had herniated through the muscular coat of the bladder. There is another type of so-called diverticula frequently seen in bladders which are hypertrophied as a result of some obstructive lesion in the prostate or urethra. This is really nothing more than an exaggerated trabeculation. They are not true diverticula, and their consideration and treatment is that of the underlying condition.

Basing my opinion on a survey of the literature and my own personal experience, I am disposed to believe that all true diverticula are congenital. Most of the cases, when carefully questioned, will give a history of some bladder irritability dating from infancy which has been very much aggravated by an attack of acute cystitis with some well defined cause or by some superinduced condition which would predispose to infection.

In the absence of infection the symptoms would be very mild in character. With the addition of infection (and the colon bacillus is the usual offending organism), there develops a particularly severe type of cystitis with very foul urine. This, of course, is due to the residuum which is more or less constantly left in the sac. Diverticula of the bladder may be suspected in any case of intractable cystitis of long standing, accompanied by very foul urine. Our suspicions are further confirmed if we can exclude any obstructive lesions or disease of the central nervous system, which would ordinarily prevent the complete emptying of the bladder with the usual accompanying infection such as tight stricture, prostatism or tabes. We must bear in mind also that diverticula not infrequently are found co-existing with these latter maladies.

Patients with this trouble present themselves with the usual symptoms of a severe chronic cystitis—frequency of urination, dysuria, nocturia and cloudy foul-smelling urine. They will occasionally give a history of apparently emptying the bladder completely, and directly after following some change of posture, will again pass a considerable amount

[1] Read at a meeting of the Genito-Urinary Section of the New York Academy of Medicine, December 18, 1918.

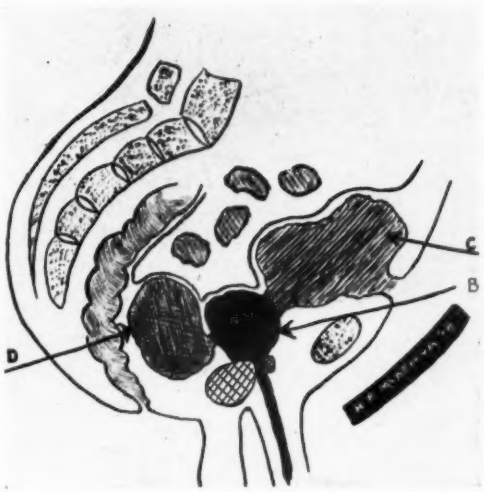

Fig. 1. Condition found at operation in author's first case. *B*, Bladder; *C*, pus cavity; *D*, diverticulum.

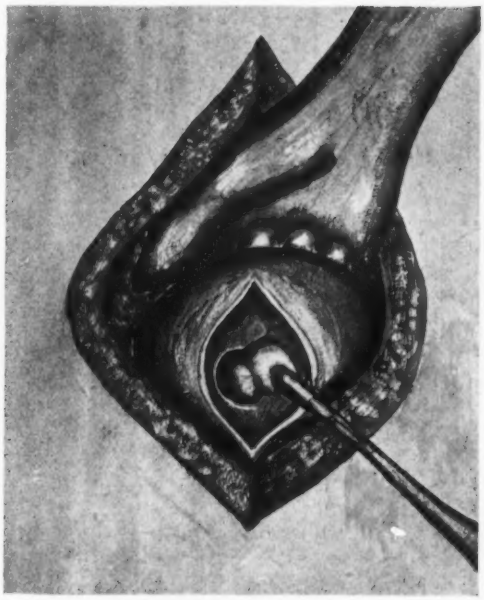

Fig. 2. Illustrating beginning of combined extra- and intravesical manipulation.

of particularly foul urine. This symptom, when accurately noted, is strongly suggestive and is, of course, caused by the diverticulum emptying its contents into the bladder with the change of position. All of my cases have been subjected to a more or less prolonged course of internal medication and bladder washings, the attending physician evidently having contented himself with the very inadequate diagnosis of chronic cystitis. (One of my cases had a suprapubic cystotomy at the hands of a general surgeon without having a diagnosis made before, at, or after operation.)

The diagnosis can usually be definitely and positively established by routine cystoscopy which is always indicated in such cases. One may note the location, size, and shape of the orifice of the diverticulum and its size may be fairly well estimated by passing into it a urethral catheter until it touches bottom. A more accurate estimation of the size, shape, and location of the wall of the diverticulum may be obtained by the employment of cystography. For this purpose, I have been using of late a 25 per cent solution of sodium bromide, as recommended in a recent paper from the Mayo clinic, and find it very satisfactory. It is cheap, easily sterilized, and gives a good picture. Cystograms should be made in two diameters and stereoscopically. In this way, we can often get a clear picture of the diverticulum and its relation to adjacent structures, which is of material help in the application of operative relief. Cystoscopy in these cases is sometimes very simple and sometimes quite the reverse owing to the difficulty of securing a clear medium in the badly infected bladder. It will often be necessary to employ a prolonged irrigation of the bladder with gallons of fluid before a satisfactory view can be obtained; in fact, there are a few cases such as the one I am about to relate in some detail, where it is absolutely impossible to perform a satisfactory cystoscopy. In this particular case, several attempts were made with and without an anæsthetic, but in spite of copious irrigation, large strings of tenacious mucus would stick to the bladder wall and the lens of the cystoscope in such a way as to minimize definitely the information obtained. In such cases, we must rely upon other aids to diagnosis such as the symp-

tomatology, character of the urine, cystography and rectal examination. As a last resort, exploratory cystotomy may be indicated.

TREATMENT

Obstructive conditions in the urethra or at the bladder neck must be eliminated by appropriate measures. Urethral strictures must be dilated. If prostatic obstruction exists, it should be removed as a separate procedure, excising the diverticulum at a later sitting when the patient has recovered from his first operation.

The methods of surgical attack for the radical cure of diverticula may be classified in three groups:

1. Suprapubic cystotomy with simple incision of the neck of the diverticulum in one, two, or more places, as first suggested by Chute, the object being to enlarge the orifice and provide for better drainage into the bladder. This is rather a risky procedure because of the danger of postvesical extravasation and has, I believe, been abandoned.

2. A plastic operation within the bladder ingeniously worked out by Squier, by means of which the wall between the bladder and the diverticulum is clamped in two places, cut between and sutured, thus converting the two cavities into one.

3. The radical extirpation of the diverticulum *in toto*, by means of intra- or extravesical or combined manipulation, suturing the defect in the bladder wall either from without or within the bladder. This latter procedure appeals to me as the logical method of attack. Young has recently devised an ingenious method to facilitate the radical excision by intravesical manipulation through a suprapubic wound. He draws the sac or its mucous membrane into the bladder by applying an electric suction pump to the orifice, completes the excision and repairs the bladder wall all from within. He has employed this method in several cases with entire satisfaction.

The following case seems worthy of reporting in some detail, because of the large size of the diverticulum, the unusual severity of the symptoms, the excellent result obtained, and a few minor modifications of the usual technique of operative attack.

Fig. 3. Photograph of specimen in author's first case.

T. J., male pharmacist; Scotland; married; 54 years old. First seen on July 6, 1917. Family history negative. As far back as he can remember, he has had a slightly irritable bladder, moderate frequency and urgency by day, nocturia once. Twenty years ago he had a severe attack of typhoid, complicated by cystitis which was treated with bladder irrigations continued for a while after his convalescence from typhoid. His bladder was much improved by this treatment but since that time he has been troubled with rather more frequency than previously. He remained in much the same condition with no improvement or increase in his trouble until one year ago when he became worse; he was obliged to rise four or five times every night; there was considerable pain with each act of urination and his urine was very foul. This condition remained about the same for four months, in spite of large doses of hexamethylene tetramine and frequent bladder washings with various solutions. He was then subjected to operation. A suprapubic cystotomy was performed by a general surgeon, who told him that he had divided some sort of a band in his bladder and assured him that he would go on to a complete recovery. He has had no relief from his operation — on the contrary, his condition is much aggravated. He has had daily bladder irrigations; his suprapubic wound is still leaking; he urinates every hour day and night; he has severe tenesmus and takes an opiate every night for its relief.

Fig. 4.

Fig. 5.

Examination discloses a cachectic appearing individual. There are no evidences of any organic disease other than the lesion in the bladder. His suprapubic fistula is protected by a copious dressing, which is saturated with a mixture of pus, sloughing tissue, and very foul urine. The operative wound is sloughing and surrounded by a red, fluctuating area. The urine passed *per urethram* is milky and very foul. It is loaded with pus, and culture shows bacillus coli. A catheter passes easily and there is apparently no residual urine. The bladder capacity is four ounces. Rectal examination discloses a prostate which is normal to the touch, the vesicles are not felt; above the prostate one notices a sense of resistance and slight tenderness. The patient was referred to the Brooklyn Hospital for further examination and treatment. Several cystoscopies made at intervals of three or four days were unsatisfactory, because of the utter impossibility of securing a clear medium. A provisional diagnosis of diverticulum of the bladder was made and it was decided to perform a preliminary cystotomy for the purpose of temporarily relieving his symptoms, overcoming in a measure the infection in and around the bladder and definitely establishing a diagnosis.

Operation, August 3, 1917. Incision at the site of the previous operation opens at once into a large abscess cavity with sloughing necrotic walls; at the bottom of this cavity there is a small opening apparently into a pocket. Upon stretching the opening with the fingers, there is a gush of pus and urine. At the bottom of this pocket, there is another opening also admitting one finger, which apparently passes directly into the bladder. When this latter opening is stretched, several ounces of very putrid urine escapes. Upon further careful investigation, it is discovered that what appears to be a pocket of an abscess cavity is really a much contracted bladder, and that what appeared to be bladder is a large diverticulum. The condition noted is very well illustrated in Figure 1. It is to be noted that the diverticulum is considerably larger than the bladder which is much contracted. The necrotic material was cleared away so far as possible; the opening in the diverticulum was stretched to admit four fingers. A large rubber drainage tube was inserted in the diverticulum and anchored to the bladder wall; another tube was passed in the bladder through a median perineal section. The bladder was packed with iodoform gauze. Another iodoform gauze strip was placed in front of the bladder. No sutures were employed other than those used to anchor tubes to the bladder. The bladder and cavity of the diverticulum were irrigated daily with silver nitrate 1:1000. The perineal tube was removed on the third day, the suprapubic tube on the tenth day. The patient left the hospital on August 26, 1917, feeling much improved. There is still a slight leak from the suprapubic fistula which, however, is clean and evidently healing. The urine is still turbid but markedly improved. He was referred to his family physician with the suggestions that he be kept on urinary antiseptics by mouth and daily bladder irrigations.

October 5, 1917. The patient is very much better. The urine is turbid. There is still a little leak from sinus, which was curetted.

November 26, 1917. The patient is much improved, sleeps all night, and keeps dry. There is an occasional slight leak from the sinus. The urine is rather foul. Residue — five ounces. He is going South for the winter.

May 3, 1918. He has had a fairly comfortable

winter, although not quite so well as when last seen. He gets up three or four times at night; there is some dysuria; the urine is very turbid and foul; residue — eight ounces.

May 8, 1918. Operation at the Brooklyn Hospital.

The bladder was widely exposed and opened through a suprapubic incision; the orifice of the diverticulum which now readily admitted two fingers was stretched to admit four fingers; the peritoneum was reflected with difficulty because of dense adhesions, the urachus was clamped, cut and tied, and the bladder freely mobilized; the diverticulum now appeared deep in the pelvis behind the bladder extending well over to the right side and densely adherent to the adjacent structures. The pelvic vessels and ureter on the right side were identified and carefully avoided. Dissecting the mass free from adhesions proved to be a very difficult matter, but was materially assisted by partially invaginating the upper and more accessible portion into the bladder, grasping it with a hæmostat and making traction while proceeding with the rest of the dissection. The beginning of this part of the operation is illustrated in Figure 2. The deeper portions of the diverticular wall were successively grasped with a hæmostat as the dissection proceeded. I doubt if it would have been practical to have completed the dissection by entirely extravesical manipulation. The whole mass including all the coats was then invaginated into the bladder and amputated. The defect in the posterior bladder wall was repaired from within with interrupted chromic sutures. The operation was completed by placing two cigarette drains behind the bladder, bringing one out on either side of the bladder. Another drain was placed in the space of Retzius, and the wound in the anterior bladder wall was repaired with interrupted chromic sutures around a drainage tube at the upper angle. The diverticulum when removed measured 10 x 8 centimeters inside; the walls were ½ centimeter thick and were composed of muscular and fibrous tissue. Figure 3 is a photograph of the specimen, unfortunately rather poorly mounted and preserved, taken some months after its removal. The patient made a very smooth recovery and left the hospital in 23 days. There was still a slight leak from the suprapubic fistula. This was entirely closed in two weeks after leaving the hospital. At present (November 7, 1918) the patient is apparently perfectly well. He sleeps all night, urinates normally and the urine is clear.

More recently I have operated upon two other cases following the same line of procedure with equally gratifying results. The specimens, which are actual size photographs, are shown in Figures 4 and 5. One of these cases was complicated by a prostatic adenoma, which was removed suprapubically at a preliminary operation, at the same time forcibly stretching the diverticular orifice. The patient was allowed to return to his home, and three weeks after his first operation, he returned to the hospital for the excision of his diverticulum. The other case was subjected to a preliminary cystotomy at which time the orifice of the diverticulum was stretched. Its cavity as well as the bladder was irrigated daily for one week at the end of which time the radical operation was performed. I believe it would have been better to have deferred the excision to a later period. Operating as I did in this case, one week after the cystotomy I found the bladder wall very friable, which added considerably to the difficulties involved. In both these latter cases, the ureter opened into the diverticulum. It was cut through and very readily implanted without tension in the bladder at the site of amputation. In each instance it passed over the sac to its point of entrance so that there was plenty of redundant ureter.

CONCLUSIONS

The points of interest are:

1. It would seem to me that simple excision of the mucous membrane is hardly enough and that unless we remove the whole diverticulum with all its coats, we are inviting a recurrence of trouble.

2. I believe it is worth while in bad cases to attack them in two stages, contenting ourselves at the first sitting with a somewhat prolonged drainage of the bladder, and by forcibly stretching the orifice of the diverticulum provide better drainage for it, reserving the radical excision for a later operation.

3. The dissection in difficult cases is facilitated by combined extra- and intravesical manipulation, invaginating the entire sac with all its walls and completing the operation from within the bladder.

TRAUMATIC RUPTURE OF THE NORMAL SPLEEN[1]

By A. MURAT WILLIS, M.D., F.A.C.S., Richmond, Virginia
Professor of Clinical and Operative Surgery, Medical College of Virginia

SUBCUTANEOUS traumatic rupture of the spleen is unusual without other serious injuries; especially is this true if the spleen is not markedly enlarged or unduly movable. The four cases which I wish to report occurred in our service in a period of approximately three years. The first was on August 24, 1914, and the last October 7, 1917.

Case 1. B. F. V., male, white, age 28 years, entered the hospital August 24, 1914, with a history of an abdominal injury.

The family and past histories were unimportant.

Personal inspection. In a runaway accident at night, 24 hours before his admission, the patient's horse suddenly turned and carried the vehicle up a two-foot embankment. The patient was thrown against the dash-board (the angle of which pressed sharply under the left costal arch) and out of the buggy. The wheels passed over him, but he was not dragged. Although he suffered with dizziness and an agonizing pain in the left shoulder, he regained his feet and stumbled around looking for his horse for a period of about 10 minutes. With the aid of a companion he walked about 1 mile to his home, where he spent a most uncomfortable night, owing to the agonizing pain in his shoulder, which seemed to be accentuated in a recumbent position. He was thirsty, had profuse sweats and grew excessively weak during the night, and as the day progressed these symptoms seemed to become worse. He was nauseated about 10 a.m. and vomited (vomitus contained no blood). His urine was very scanty and a catheterized specimen showed a small quantity of blood.

Physical examination. The patient was seen about 24 hours after the accident. At this time his temperature was 96°; pulse 94, regular and of small volume; respirations 34, short and superficial; and he complained of pain with each respiratory movement. He was pale and had a sharp, pinched expression about the face and nose. The lungs and heart were normal and there were no bruises on shoulders or thorax. The abdomen was slightly rigid and markedly tender, and there was dullness in the left flank. There was no fracture of ribs or other bones.

Hæmoglobin: 70 per cent; white blood count, 26,100.

Urine: straw color; cloudy; acid; specific gravity, 1020; albumin plus; sugar negative. Microscopic examination showed numerous pus and red cells; few granular and blood casts.

Diagnosis: abdominal hæmorrhage from ruptured spleen or liver.

Operation. Under cocaine anæsthesia 27 hours after injury, a left rectus incision was made. On opening the peritoneal cavity a large amount of free blood was encountered. It was thought best to continue the operation under ether anæsthesia. The incision was rapidly enlarged and hand passed in the cavity; the spleen was examined and found to be enveloped in large blood clots. These were removed and there was active bleeding. An open rent was felt along the posterior convex surface extending the whole length of the spleen. Owing to the short pedicle we encountered considerable difficulty in making a proper ligation and removing the organ. The patient at this time was in considerable shock. Hypodermoclysis was started and a rapid closure of the wound was then made.

Shortly after operation the condition of the patient became so serious that it was thought best to use transfusion. The patient's mother acted as donor and blood was allowed to flow for a period of 15 minutes. Immediate improvement commenced with the introduction of fresh donor's blood into the vein.

The patient reacted well and made a fair convalescence. He was discharged from the hospital 5 weeks later.

Blood findings, August 27: leucocytes, 10,600; hæmoglobin, 70 per cent. Differential count: polymorphonuclears, 82 per cent; lymphocytes, 18 per cent.

September 1: hæmoglobin, 65 per cent; total reds, 4,800,000.

September 5: white blood count, 35,000; polymorphonuclears, 88 per cent.

September 12: total leucocytes, 25,000; hæmoglobin, 65 per cent; polymorphonuclears, 86 per cent.

Urine, August 26: amber color: cloudy; acid; specific gravity, 1022; albumin plus; sugar negative. Microscopic: pus cells and red blood cells.

August 27: amber color; cloudy; acid; specific gravity, 1018; albumin, large amount; sugar negative; abundant pus.

Pathological report. The spleen, on inspection, was normal in size, color and consistency. On its posterior surface there was a rent extending the full length of the spleen. On the upper border there was a laceration 1 centimeter deep and 3 centimeters in length.

Microscopical report. Malpighian bodies and splenic pulp presented a normal picture. There was an increase in connective tissue.

Case 2. (Occurred in the service of my associates, Doctors Motley and Smith.) C. R., male, white,

[1] Read before the Southern Surgical Association, December, 1917.

age 14 years, entered the Abingdon Hospital with a history of an abdominal injury.

The family and past histories were unimportant.

Personal inspection. While coasting the patient was thrown from his sled and he collided with a large tree, striking his left lower chest and upper abdomen. The accident caused considerable pain and dizziness. He managed to walk across the street to a store and later was taken home in a conveyance. He was seen by a physician almost immediately after the accident. The physician noted a temperature of 96° and pulse of 90. At this examination the patient was rigid and tender over the left side of his abdomen. Twenty hours later his temperature was 101° and pulse 140.

Physical examination. Twenty-seven hours after the accident the patient was admitted to the hospital with a temperature of 100° and pulse of 140. He complained bitterly of an agonizing pain in the left shoulder. This pain was not accentuated by the movement of the shoulder-joint, nor was there any evidence of trauma. He also complained of pain in his chest and abdomen. Chest examination showed dullness and absence of breath sounds over the lower posterior border of the left lung. The abdomen was flat, except for a slight distention of the epigastrium. On palpation the abdomen was extremely rigid and tender throughout, and on percussion there was dullness in the left flank extending outward as far as the axillary line, and upward to the dullness noted in left chest.

The urine was negative. The hæmoglobin was 70 per cent and leucocytes 16,000.

Operation. Under ether anæsthesia a high left rectus incision was made. As soon as the peritoneum was opened a large quantity of blood gushed out. The spleen was located, clamps were applied to the pedicle, and it was removed. The stumps of the vessels were sutured with No. 4 catgut, the blood was sponged out of the peritoneal cavity, and posterior drainage was inserted.

The patient had lost an appalling amount of blood. Soon after operation his condition became so desperate that a direct transfusion was performed by means of Bernheim tubes. A nurse acted as the donor. Almost immediately after the blood began to flow the patient's lips became pink, the color returned to his cheeks and he awoke and began to talk rationally.

The postoperative course was somewhat marred by a pleural effusion on the left side.

Blood findings: December 18: leucocytes, 16,000; hæmoglobin, 70 per cent; polymorphonuclears, 88 per cent; small mononuclears, 7 per cent; large mononuclears, 5 per cent.

December 21: leucocytes, 30,000; hæmoglobin, 68 per cent; erythrocytes, 3,500,000; polymorphonuclears, 80 per cent; small mononuclears, 11 per cent; large mononuclears, 9 per cent.

December 23: leucocytes, 21,000; hæmoglobin, 65 per cent; erythrocytes, 4,000,000; polymorphonuclears, 83 per cent; eosinophiles, 5 per cent; small mononuclears, 4 per cent; large mononuclears, 8 per cent.

December 26: leucocytes, 20,000; polymorphonuclears, 70 per cent; small mononuclears, 8 per cent; large mononuclears, 8 per cent; eosinophiles, 14 per cent.

December 31: leucocytes, 20,000; erythrocytes, 4,200,000; polymorphonuclears, 75 per cent; small mononuclears, 10 per cent; large mononuclears, 1 per cent; eosinophiles, 14 per cent.

January 5: leucocytes, 20,000; hæmoglobin, 70 per cent; red cells, 3,800,000; polymorphonuclears, 76 per cent; small mononuclears, 10 per cent; large mononuclears, 4 per cent; eosinophiles, 10 per cent.

January 11; leucocytes, 16,000; hæmoglobin, 70 per cent; red cells, 3,800,000; polymorphonuclears, 72 per cent; small mononuclears, 4 per cent; large mononuclears, 15 per cent; eosinophiles, 9 per cent.

Pathological report. The spleen was slightly enlarged for one of his age, measuring 9.5 centimeters in length by 7 centimeters in breadth by 2.5 centimeters in thickness. The color and consistency were normal. On its anterior surface there was a rent extending through the middle of the spleen.

Microscopic report. The malpighian bodies were few in number and were pressed apart by an increase of splenic pulp. This increase was due to an infiltration with leucocytes and lymphocytes.

CASE 3. C. P. G., male, white, aged 46 years, entered the Johnston-Willis Sanatorium, November 12, 1916, with a history of an injury in an automobile accident.

The family and past histories were unimportant.

Personal inspection. The patient stated that he was injured in an automobile accident which occurred while driving his car over wet roads. He lost control of the car. The car turned over and he was caught between the steering wheel and seat, injuring him in the abdomen. He was released by his companions and stated that he was seized with violent pains in his left shoulder and under the costal arch of the left side. He was moved to a house nearby the roadside, where he stayed for two hours before being seen by a physician.

When first seen in the automobile on arrival at the hospital, he was breathing with much difficulty. He had his right hand placed on his left shoulder, stating that he was suffering agonizing pain in this region, and under the left costal arch.

When placed in bed it was found that his pain was greatly increased when he was in the recumbent position.

Physical examination revealed nothing on inspection except that the patient was breathing with much discomfort and he had an anxious expression. There was not an abrasion or bruise on the skin surface. His temperature was 96°, pulse 80, respiration 22, skin cold and clammy. He was tender all over the abdomen; very rigid, showed much tenderness in the left costovertebral angle. The pain in the shoulder, of which he complained, was not accentuated by palpation.

Blood findings showed total white cell count 25,200 with a hæmoglobin of 90 per cent at 7 o'clock; one hour later his total white cell count was 23,600 and hæmoglobin 70 per cent.

A provisional diagnosis of a ruptured spleen was made from the foregoing data and it was thought best to do an exploratory laparotomy under local anæsthesia to confirm the diagnosis.

Operation. On entering the peritoneal cavity through a left rectus incision a large amount of free blood was encountered. We deemed it wise to switch to a general anæsthetic. We enlarged the incision, located the pedicle of the spleen, which was shorter than normal and somewhat adherent by old adhesions. As we were unable to get free access to this organ, our incision was enlarged by making a left transverse incision. The pedicle was ligated, the ruptured spleen removed and all the free blood removed with the suction apparatus. The wound was closed with drainage. Hypodermoclysis was given on the table. The stomach was washed and a large amount of dark green fluid was obtained.

A transfusion was advised by my associate, Dr. Budd, but he was unable to match his blood with the donors, among several of whom was his son. The patient reacted well and seemed to improve for the next few days.

Blood findings the next day, November 13, were as follows:

Total white cell count, 17,600; hæmoglobin, 70 per cent; polynuclear, 70 per cent; small lymphocytes 16 per cent; large lymphocytes, 14 per cent.

November 14: leukocytes, 10,800; hæmoglobin, 70 per cent. Differential not made.

November 15: leucocytes, 8,000; polymorphonuclears, 66 per cent; small lymphocytes, 12 per cent; large lymphocytes, 22 per cent; hæmoglobin, 68 per cent.

November 16: leucocytes, 7,200; hæmoglobin, 60 per cent.

November 19: leucocytes, 7,000; polynuclears, 88 per cent; lymphocytes, 12 per cent; hæmoglobin, 60 per cent.

Pathological report. The spleen was not enlarged; the color and consistency were normal. There was a stellate rent on the anterior surface of the spleen, covering a little over half of the surface.

The patient was given continuous saline, nothing by mouth, hypodermoclysis and morphin, 1/6 grain, every 4 hours when necessary. His stomach was washed repeatedly, which always brought back a good deal of dark green fluid. He suffered a great deal from distention, which we were unable to relieve by the ordinary methods. The patient's condition seemed about the same for the next 7 days, but on the eighth day he began to suffer more than usual with distention; the pulse became weak and rapid and on the eighth day he died. No autopsy.

CASE 4. F. C., male, colored, age 15 years, entered the hospital September 12, 1917, with a history of an injury in an automobile accident.

Personal inspection. First seen by his family physician about one hour after the accident. At the time he was unconscious and showed symptoms of concussion of the brain and those of an abdominal injury.

Physical examination. Three hours after the accident the patient was admitted to the hospital in a semiconscious condition. There was a slight laceration of the scalp over the right parietal region. There were no other evidences of injury on other portions of the body. His temperature was 98.4°, pulse 74, respiration 26. Reflexes normal; eyegrounds normal; consciousness returning. Chest negative. Upon examination the abdomen was slightly distended; slight rigidity and tenderness over the entire abdomen, increased over left rectus muscle.

The urine was negative.

Blood on admission: leucocytes, 22,800; polynuclears, 81 per cent; lymphocytes, 19 per cent; hæmoglobin, 90 per cent. Blood examination two hours later: leucocytes, 22,000; polynuclears, 86 per cent; lymphocytes, 9 per cent; large mononuclears, 5 per cent; hæmoglobin, 70 per cent.

Abdominal pain increased, pulse rose to 116, temperature 100.4°, respiration 40; hæmoglobin, 70 per cent.

Diagnosis: internal hæmorrhage from rupture of liver or spleen.

Operation. Twenty-four hours after the accident the abdomen was opened through a median incision, extending from the costal arch down 4 inches. The peritoneal cavity contained a large amount of blood. The liver was thoroughly explored for fracture, but no injury could be discovered. The spleen was next palpated and evidences of injury could be made out, although the incision did not permit a satisfactory examination. A transverse incision was then made through the abdominal wall from the mid-point of the first incision to just beneath the left costal arch. There was a blood-clot adherent to the spleen, which on further examination showed two lines of fracture. The injury was confined to the inferior half, the upper line being just beneath the center of its longitudinal axis. The organ seemed to be somewhat enlarged and had only a slight range of movement either on account of very short ligaments or else anomalous fixation bands. It seemed to be firmly fixed and some little time was required to mobilize it sufficiently to permit a ligation of the vessels. This was done with No. 2 tanned catgut. The wound was closed in layers in the usual way, without drainage. The patient stood the operation fairly well and was given subcutaneous saline, leaving the table with a pulse of 130. Postoperative convalescence was satisfactory.

Blood findings, September 19: leucocytes, 8,400; hæmoglobin, 65 per cent; red cells, 4,320,000. In the course of the next ten days hæmoglobin fell to 60 per cent, and then slowly increased, reaching 70 per cent three weeks after operation; white cell count at that time was normal.

In summing up the histories of these 4 cases we find that all present the following points in common:

1. They were all males.
2. Blow on left side of body in splenic region.
3. Secondary anæmia and leucocytosis.
4. No external evidence of injury about the body.
5. Rigidity and tenderness of the abdomen.
6. All had shock following splenectomy.
7. All the spleens were practically normal in size with short pedicles and without any history of previous disease of the organ.

Three out of the four had agonizing pain in the left shoulder, which was promptly relieved by splenectomy. The fourth case was a child sent in for concussion of the brain, and as he was in a semiconscious condition we were unable to elicit a satisfactory history.

Three were operated on twenty-four hours after the injury.

In 2 of the cases a marked increased leucocytosis persisted after the operation over a period of from two to four weeks.

Three cases had satisfactory convalescence. One died eight days after operation.

The fatal case showed a continuous fall in hæmoglobin and a decreasing leucocyte count.

In the first 2 cases operation was followed by direct transfusion, with apparently good results.

Some years ago in a patient on whom we had done a splenectomy for Banti's disease there was a postoperative bleeding from the pedicle and a second operation was necessary to control hæmorrhage. The patient reacted very well from this operation, but died a few days later with symptoms suggesting severe anæmia. At autopsy no internal hæmorrhage was found and we did not believe that a sufficient amount of blood had been lost from the accident to account for the fatality. Since the amount of hæmorrhage found in the cavity at the time of the second operation was not sufficient to have caused death, we felt that in some way the removal of the spleen plus hæmorrhage had produced a severe secondary anæmia that would not have resulted from the loss of the same quantity of blood from any other abdominal organ. We were strengthened in this belief by the experimental findings of Musser (1) who says: "In the dog splenectomy is followed by a decrease in the red blood cells and hæmoglobin reaching the lowest level about the twenty-sixth day, the hæmoglobin varying from 50 to 65 per cent and the red cells from 2,800,000 to 3,500,000. From this time to the eighty-second day a constant increase in hæmoglobin and red cells occurs, the animal not reaching or approximating its normal level, however, until the end of about four and a half months." Pearce and Austin (2) also experimenting with dogs, showed that "in the absence of the spleen the function of forming red blood corpuscle-phagocyting cells, normally a minor activity of the lymph nodes becomes highly developed in the latter organs, and that these cells, and the stellate cells of the liver, thus assume, in part at least, the function of destroying red blood corpuscles by phagocytosis."

Having in mind the former unfortunate experience in the case of Banti's disease and also the results of Musser (1) Pearce and Austin (2) just quoted, we promptly resorted to transfusion in our first 2 cases of splenic rupture with most gratifying results. Since, however, our experience with splenectomy following hæmorrhage was small, we determined to study the points which had come to light in these cases with the aid of animal experimentation.

The points we wished to investigate were these: (1) What effect has simple splenectomy upon the blood picture? (2) What change is produced when splenectomy is performed following a considerable hæmorrhage, as was the case in our patients with ruptured spleen? (3) In what way does transfusion modify the results of splenectomy? Our experiments may be grouped under three heads: (1) splenectomy with no loss of blood; (2) splenectomy with loss of a considerable amount of blood; (3) splenectomy with loss of blood and subsequent transfusion.

In our experiments on dogs conducted by Dr. S. W. Budd and myself in 1914 and 1915, the abdomen was opened, under ether anæsthesia, by a high left rectus incision, and the spleen delivered through the wound. Ligatures were placed around the splenic artery and vein and also around the entire splenic ligament. In groups 2 and 3, the ligatures around the splenic artery and vein were not tightened until the animal

had lost blood enough to reduce the hæmoglobin to 70 per cent. Indirect transfusion was used in group 3, blood being introduced through the splenic vein. In order to simulate as nearly as possible a ruptured spleen, we lacerated the organ and squeezed part of the splenic pulp into the abdominal cavity in all experiments.

Under group 1, splenectomy with no loss of blood, eighteen dogs were used. The majority of these showed but a slight decrease in hæmoglobin; a small number showed no loss; only a few showed a marked decrease to 60 per cent in the first few weeks, with a gradual return to normal.

In group 2, splenectomy with dogs bled until the hæmoglobin registered approximately 70 per cent, fifteen dogs were used. Most of these showed the same blood picture as the last cases in group 1, which was a gradual decrease to 60 per cent, then a slow rise. One case showed a marked anæmia and died on the seventh day. Two others developed a grave anæmia, hæmoglobin going as slow as 45 per cent followed by a gradual rise.

In group 3, splenectomy, animals bled until hæmoglobin reached 70 per cent, followed by transfusion. The blood picture in this series of cases was similar to the majority of group 2. In this series 5 dogs were used.

The blood findings in our human cases that recovered simulated the majority of those in groups 2 and 3, that is, a gradual decrease in hæmoglobin as low as 55 per cent, then a return to normal. The experiments just detailed seem to establish the fact that the destruction of red cells following a simple splenectomy is by no means excessive. A few of our animals, however, showed a marked secondary anæmia following splenectomy after hæmorrhage and as a result of these observations we are led to the belief that in certain cases of splenectomy following hæmorrhage, death occurs as the result of a severe secondary anæmia out of proportion to the amount of blood lost and probably incident to the absence of the spleen.

It will be observed that the studies of the blood in these cases were not elaborate. From previous experimental work it seemed safe to assume that the anæmia present was of the secondary type and that hæmoglobin estimation represented a fair index of its degree.

We wish to call attention especially to pain in the left shoulder as a symptom of considerable diagnostic importance. This pain is undoubtedly referred from the diaphragm and is due to subphrenic irritation from blood clots around the spleen. Pain of a similar nature in cases of diaphragmatic pleurisy has been referred to by Capps (3) who states that "the central portion of the diaphragm receives its sensory nerves from the phrenic nerve, which carries afferent impulses to the cervical cord, and sets up reflex pain in the corresponding spinal segments; namely, the third and fourth cervical."

This localization of the pain was apparently first noted by Stubenrauch and Schulze and has been mentioned by Fauntleroy (4), Junkermann (5), Norrlin (7), Baur (7), Mulligan and Hennington (8), and Henschen (9).

The symptom is thus graphically described in Fauntleroy's paper: "He complained of a curious, deep-seated pain in the left shoulder, which was not increased by movement of the joint, and, as examination showed no contusion or dislocation, it was thought to be a slight sprain in this region, due to the effort to catch himself in falling. It is to be noticed, however, that this pain disappeared completely after operation, and it is possible that it has some diagnostic value when the spleen is traumatically involved." Brogsitter, however, believes that pain in the left shoulder is of little diagnostic importance, as it is seen in other instances of injury of abdominal organs, particularly of the left lobe of the liver.

In a paper published in 1909, Brogsitter (10) reviews the literature on traumatic rupture of the spleen, and states that up to that date there had been reported 203 cases of rupture of the spleen treated by surgical means. This number may be divided into two series: the first one up to and including the cases summarized by Berger in 1907, comprising a total of 168 cases; the second up to and including the cases reviewed by Brogsitter. a

total of 35. In the first series, splenectomy was performed in 135 instances, with a mortality of 38.7 per cent. In the earlier papers, there was no distinction made between ruptures of the normal and of the diseased spleen, but Brogsitter analyzed a series of 66 cases occurring between 1902 and 1909, 47 of which were ruptures of apparently normal spleens, while the remaining 19 were instances of rupture of the diseased spleen. The mortality after splenectomy was almost the same in these two series, being 35.3 per cent for the normal and 33.3 for the diseased spleens.

Barnes, in 1914, reviewed the literature since Brogsitter's paper, and finds reports of 30 cases of rupture of the normal spleen occurring between 1909 and 1914; his own case making a total of 31. Splenectomy was performed in 26 instances, with a mortality of only 7.6 per cent. There have occurred, since Barnes' paper or were omitted from his summary, 53 cases of rupture of the apparently normal spleen, the reports of which have been available, our own cases increasing this total to 57. Splenectomy was performed on 55 patients, with a mortality of 28.88 per cent. Suture, tamponade, or a combination of these two procedures appears to give a distinctly better result, for the mortality of patients treated in this way for the four series is respectively 25 per cent, 0 per cent, 0 per cent and 8.3 per cent. Too much importance should not be attached to these figures, however, for the condition of the patient at the time of operation undoubtedly was the chief factor in influencing the mortality.

The following cases have occurred since Barnes' paper or were omitted from his summary:

1. BAUR. One splenectomy — recovery. Cor.-Bl. f. schweiz. Aerzte, 1914, xliv, 1467.
2. CAM, W. H. One splenectomy — recovery. Brit. M. J., 1916, i, 199.
3. CATHCART, C. W. One tampon — recovery. Tr. Med.-Chir. Soc., Edin., 1910-11, xxx, 189.
4. COX. One splenectomy — recovery. Lancet, Lond., 1914, ii, 945.
5. ECCLES, W. MCADAM. One splenectomy — recovery. West London M. J., 1913, xvii, 207-209.
6. ELIOT, ELLSWORTH. One tampon — recovery. Ann. Surg., 1914, lix, 759.
7. FAUNTLEROY, A. M. One splenectomy — recovery. Ann. Surg., 1913, lvii, 68-71.
8. GILSON-HERMAN. One splenectomy — death. J. méd. de Brux., 1913, xvii, suppl. p. 43.
9. GROSS and HEULLY. Three splenectomies — three deaths. Rev. méd. de l'est, 1912, xliv, 452-454.
10. HAHN. One splenectomy — death. Med. Klin., 1913, ix, 585.
11. HENNESSY. Six splenectomies — four recoveries — 2 deaths. Indian M. Gaz., 1917, lii, 46-53.
12. HENSCHEN. One splenectomy — recovery. Cor.-Bl. f. schweiz. Aerzte, 1915, xlv, 504.
13. HITZROT. Two splenectomies — one recovery — one death. Ann. Surg., 1914, lix, 757.
14. HORAND. One splenectomy — recovery. Lyon méd., 1912, cxix, 918-922.
15. HUTCHESON. One splenectomy — death. Ry. Surg. J., 1914-15, xxi, 356-358.
16. JUNKERMANN. Five splenectomies — 4 recoveries; one death. Dissertation, Bonn, 1913.
17. JONES. One splenectomy — recovery. Brit. M. J., 1916, i, 200.
18. KREUTER. One splenectomy — recovery. Zentralbl. f. Chir., 1914, xl, 58.
19. LEVIN. One suture — recovery. Med. J. S. Africa, 1915-16, xi, 82.
20. LEVY. One splenectomy — recovery. Deutsche med. Wchnschr., 1915, xli, 889.
21. LIVINGSTONE. One splenectomy — recovery. Brit. M. J., 1914, i, 1183.
22. MCCRACKEN. One splenectomy — death. China M. J., 1917, xxxi, 20-24.
23. MARCHAK. One splenectomy — death. Bull. et. mém. Soc. anat. de Par., 1913, lxxxvii, 477-479.
24. MICKHAILOFF. One splenectomy — recovery. Rev. gén. de clin. et de thérap., 1913, xxvii, 439.
25. MULLIGAN and HENNINGTON. Suture and tampon — one recovery. Buffalo M. J., 1914, lxx, 80-82.
26. NORRLIN. 4 tampons — 3 recoveries, one death; 3 splenectomies — 3 recoveries; 1 suture — one recovery; 1 suture and tampon — one recovery. Arch. gén. de chir., 1913, vii, 520-540.
27. OLLER. 1 splenectomy — death; also three cases published in 1909. Rev. clin. de Madrid, 1914, xii, 341-353.
28. PALMER. One tampon — recovery. J. Am. M. Ass., lxix, 20, 1733.
29. REGLING and KLUNKER. One splenectomy — recovery. Deutsche mil.-aerztl. Zeitschr., 1911, xl, 525.
30. ROUTIER. One tampon — recovery. Bull. et mém. Soc. de chir. de Par., 1914, xl, 642.
31. SEHEULT. One splenectomy — recovery. Lancet, Lond., 1913, ii, 794.
32. STEINTHAL. One splenectomy — recovery. Med. Cor.-Bl. d. Wuerttemb. aerztl. Landesver., 1911, lxxxi, 190.
33. VASSAL. One splenectomy — recovery. Montpelier Thesis, 1911.

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MALIGNANT LEIOMYOMATA

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AMONG the specimens received at the Pathological Laboratory of the State Institute for the Study of Malignant Disease, during the past four years, that is, since we have been making diagnosis of pathological tissues free of charge for the physicians of the state, there have occurred twenty-two cases of malignant leiomyomata. It was thought to be valuable to analyze and place these cases on record.

A malignant leiomyoma may be defined as a malignant neoplasm arising from mesoblastic cells of the smooth muscle type. It is conceivable that these tumors may originate from either adult smooth muscle cells or from benign tumor cells as found in leiomyomata. The latter origin must be considered as the common one on account of the frequency with which a history of "degenerating fibroid"[1] accompanies these tumors.

Virchow, in his treaties on tumors, described in 1863 a myoma of the stomach which underwent a metaplasia to myosarcoma. While he speaks about its originating in the interstitial tissues, still his microscopic description of the cells and especially the nuclei leads one to believe that he had to deal with a true malignant leiomyoma to which he gave the name myosarcoma. Ritter described a case of a large fibromyoma of the uterus which showed sarcomatous changes at the center and to which he gave the name myosarcoma. Von Kahlden reviews the literature and, after describing many reported cases, some of which were probably cases of true sarcoma as well as malignant leiomyomata, he describes a personal case which is of especial interest because he claims one can demonstrate histologically a direct transition of a fibromyoma to a sarcoma. Williams, after a careful study, does not see how von Kahlden can exclude the possibility of the sarcoma cells springing from the interstitial connective tissue, although he himself described a case in the sections of which he could demonstrate an actual transition of myoma cells to sarcoma cells. Almost all authors of this period speak of these tumors as myosarcoma, but as Ribbert points out, the name sarcoma should be reserved for malignant tumors springing from connective tissue. For the smooth muscle tumor which has undergone malignant change he suggests the name of malignant myoma; and he would only use the term myosarcoma for the extremely rare cases when true sarcoma and myoma exist at the same time producing a mixed tumor. Ribbert also emphasizes the fact that the term malignant degeneration of a "fibroid" is improper usage inasmuch as a tumor is not a regressive but distinctly a progressive process. Much discussion has arisen regarding the best terminology to use to designate these tumors arising from the smooth muscle type of cell. Mallory would include all tumors both benign and malignant which are composed of the smooth muscle cell type under the general term leiomyoblastoma. Williams prefers the term myomasarcomatodes because it signifies a sarcoma-like tumor which springs from the muscle cells of a myoma. Aschoff, Kauffmann, and Hertzler use the term myosarcoma while MacCallum prefers the term malignant myoma. It would seem most

[1] Fibroid seems an expressive term and is frequently used in this paper instead of the more cumbersome term "leiomyoma."

rational to use the term suggested by Morpurgo, and also used by Ghon, viz., malignant leiomyoma, as this covers the ground and instantly shows one that we are dealing with a malignant tumor comprised of the smooth muscle type of cell. It would seem that we must exclude from this group of malignant smooth muscle tumors so-called metastasizing myoma, for they are probably really benign and metastasize as the result of the cells of a leiomyoma penetrating a blood-vessel and producing another tumor at the place where these cells become lodged.

Malignant leiomyomata are not infrequent and if a more careful examinaton of all "fibroids" were made we believe that the statistics reported in the literature would be greatly increased. It is not unusual to find that a single nodule in a uterus containing multiple tumors, would show a malignant change. Often the change may be limited to the center of the fibroid. Kelly and Nobel, Tracy and Murphy find the incidence of malignant tumors in relation to fibroids to vary between 1 and 2 per cent, while the statistics of Gardner and Winter show about 3 per cent. In the cases received at this Laboratory there occurred twenty-two malignant tumors among 357 leiomyomata or about 6 per cent. This percentage is much higher than any previously reported but may be partly accounted for by the fact that a specimen with any appearance of malignancy would be more likely to be sent to us for examination while benign tumors might be thrown away.

The majority of these neoplasms occur in the body of the uterus and preponderately arise from pre-existing "fibroids." Sixteen of our twenty-two cases give a definite history of preceding leiomyoma. One case which consisted of multiple malignant tumors varying from the size of a pin head to a marble apparently sprang primarily from the musculature of the uterus, while two other of the cases gave a history of uterine polyps.

The gross appearance, of course, varies with the stage of progress of the malignant condition when found. In the case of the multiple small tumors which were unquestionably rather early, these tumors were circumscribed nodules such as one finds in leiomyoma but did not give the whorl appearance and were quite homogeneous, presenting a grayish white color. When this malignant change is found at the center of an old "fibroid," that area may present a grayish white to reddish appearance and is soft in consistency. The large ulcerating protruding mass as found in advanced cases is of a marrow white appearance and the consistency of brain tissue. It bleeds easily and is extremely fragile. Sometimes the tumor at this stage protrudes from the cervix into the vagina and reminds one of carcinoma.

The histological aspect varies probably with the rapidity of growth and the degree of malignancy. Some authors include in the group of malignant smooth muscle tumors, very cellular leiomyomata and, of course, it is very hard to draw the line, but it would seem that the absence of mitotic figures ought to put doubtful tumors in the benign class, as mitotic figures are extremely rare in leiomyomata. Mallory writes: "When mitotic figures are present in leiomyoblastoma the tumor is to be regarded as capable of infiltration and of giving rise to metastases and therefore as clinically malignant." Histologically, therefore, the tumors may vary from those made up of cells of uniform size resembling those which make up leiomyoma but being somewhat shorter and plumper with here and there a mitotic figure up to tumors comprised of cells which are extremely irregular in size and shape, some being masses of protoplasm with giant or multiple nuclei and showing all varieties of atypical mitotic figures. Mallory described the type cell of a leiomyoblastoma as a long spindle cell with a rod-shaped nucleus and acidophilic protoplasm. We believe that it should be possible in all malignant leiomyomata to find somewhere in the tumor this type of cell. One may classify malignant leiomyomata histologically into three types according to their variation from the smooth muscle type cell: (1) those resembling very closely the leiomyomata, (2) those having a short plump spindle shape with oval nuclei, and (3) those having a great variation in the morphology of the cells.

Fig. 1 Fig. 3 Fig. 5

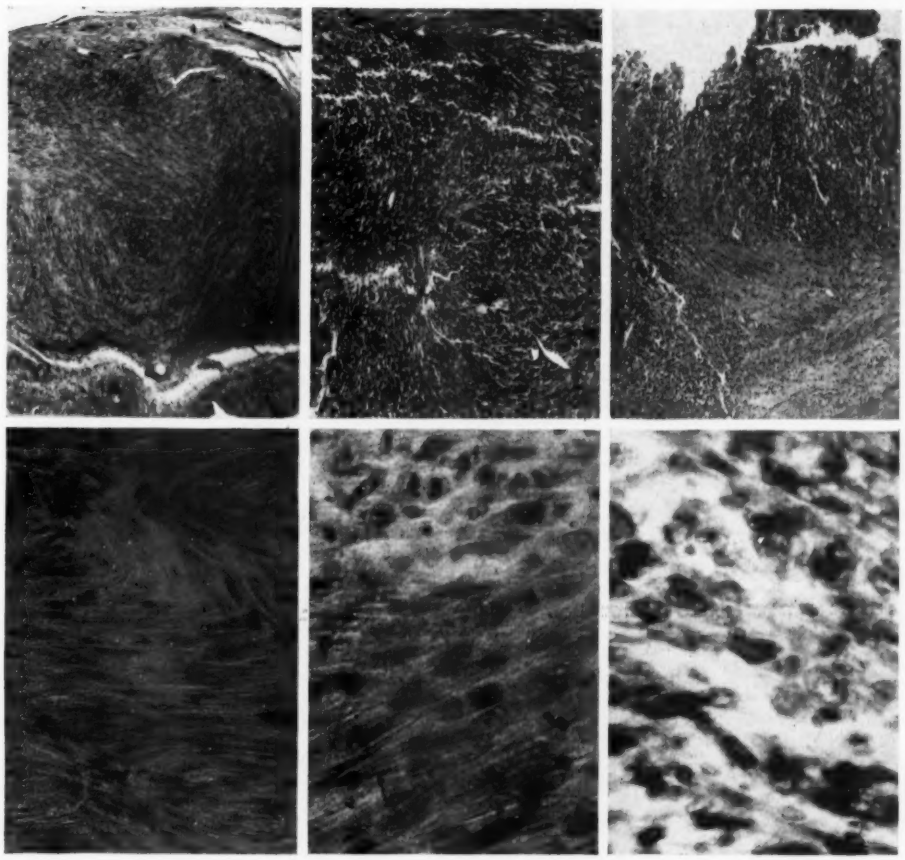

Fig. 2 Fig. 4 Fig. 6

Fig. 1. [1] Type I. Low power showing one of several nodules which apparently sprang from the uterine wall.

Fig. 2. Same section high power, showing spindle-like cells with rod-shaped nucleus.

Fig. 3. Type II. Low Power.

Fig. 4. Same section high power. Note typical mitotic figures.

Fig. 5. Type III. Low power showing malignancy penetrating the musculature.

Fig. 6. Same section, high power, showing variations in cell structure and an atypical mitotic figure.

[1] We are indebted to Dr. A. J. Hay for the accompanying microphotographs.

The first type (Figs. 1 and 2) is composed of long spindle cells with a rod-shaped nucleus having rounded ends. The cells are shorter than the type cell with relatively more protoplasm, tend to regularity in size, and mitotic figures are infrequent. The second type (Figs. 3 and 4) is composed of shorter, plumper spindle cells, an oval and vesicular nucleus with numerous typical and atypical mitotic figures. The third type (Figs. 5 and 6) shows a great variation in the morphology of the cells and consists of short spindle cells, large round cells, and numerous giant cells containing single or multiple nuclei and presenting great irregularity of the chromatin elements. Undoubtedly these different histolog-

ical appearances are indicative of different degrees of malignancy for the reports of the results of these cases, so far as we were able to ascertain, agree very well with the histological findings; that is, those cases which showed much variation in cell structure suffered recurrences with ultimate death, while the cases, still living, were of the type which showed least deviation from the leiomyoma type cell.

For purposes of reference a brief history of our cases is given below which includes the outcome of each as far as we are able to ascertain; also the type from the histological standpoint.

CASE 1. Path. No. 1917. Date, October 17, 1914. Age 64, married. Clinical diagnosis: adenocarcinoma. Location: mass in cervix. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died 6 months later, whole abdomen involved.

CASE. 2. Path. No. 2546. Date, May 3, 1915. Age 40, married. Clinical diagnosis: uterine polyp. Location: fundus near left tubal opening. Microscopic diagnosis: malignant leiomyoma. Type II. Result: died 7 months after operation from recurrence.

CASE 3. Path. No. 2799. Date, July 6, 1915. Age 47, married. Clinical diagnosis: cancer of cervix. Location: protruding mass from the cervix. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died in 6 months from recurrence.

CASE 4. Path. No. 3545. Date, December 16, 1915. Age 72, married. Clinical diagnosis: growth from vagina. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died 7 months later, exact cause not known.

CASE 5. Path. No. 4090. Date, April 1, 1916. Age 41, married. Clinical diagnosis: degenerating fibroid. Location: center of large fibroid. Microscopic diagnosis: malignant leiomyoma. Type II. Result: alive and apparently well.

CASE 6. Path. No. 4563. Date, June 7, 1916. Age 55, married. Clinical diagnosis: "sloughing fibroid" with possible cancerous degeneration. Location: recurrence from fibroid removed four months previous. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died 6 months later after another recurrence.

CASE 7. Path. No. 4726. Date, July 1, 1916. Age 52, married. Clinical diagnosis: fibroid with a history of hæmorrhage. Location: body of uterus. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died 9 months later.

CASE 8. Path. No. 5097. Date, September 11, 1916. Age 48, married. Clinical diagnosis: degenerated fibromyoma. Location: uterus — large leiomyoma. Microscopic diagnosis: malignant leiomyoma. Type II. Result: alive, no evidence of recurrence.

CASE 9. Path. No. 5360. Date, November 24, 1916. Age 54, married. Clinical diagnosis: "submucous fibroid." Location: cavity of uterus. Microscopic diagnosis: malignant leiomyoma. Type II. Result: still living and well.

CASE.10. Path. No. 5679. Date, December 16, 1916. Age 47, married. Clinical diagnosis: carcinoma. Location cavity of uterus, filled with growth consistency of brain. Microscopic diagnosis: malignant leiomyoma. Type I. Result: patient at present well.

CASE 11. Path. No. 6142. Date, February 27, 1917. Age 58, married. Clinical diagnosis: fibroid metrorrhagia. Location: uterus. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died at operation.

CASE 12. Path. No. 7398. Date, September 12, 1917. Age 64, married. Clinical diagnosis: fibroid with malignant degeneration. Location: uterine wall. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died week following operation. Entire pelvis filled with growth.

CASE 13. Path. No. 7409. Date, September 13, 1917. Age 32, single. Clinical diagnosis: multiple fibroids. Location: body of uterus. Microscopic diagnosis: malignant leiomyoma. Type I. Result: health good.

CASE 14. Path. No. 7613. Date, October 15, 1917. Age 65, married. Clinical diagnosis: "broken-down fibroid." Location: large fibroid in uterine wall. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died 11 months later with abdominal metastases.

CASE 15. Path. No. 7914. Date, December 1, 1917. Age 62, married. Clinical diagnosis: fibroid undergoing malignant degeneration. Location: large uterine fibroid. Microscopic diagnosis: malignant leiomyoma. Type II. Result: died 16 days later from operation. Pulmonary embolism.

CASE 16. Path. No. 8554. Date, March 20, 1918. Age 65, married. Clinical diagnosis: cancerous degeneration. Location: submucous fibroid. Microscopic diagnosis: malignant leiomyoma. Type III. Result: died 6 months later with recurrence.

CASE 17. Path. No. 8853. Date, April 17, 1918. Age 47, married. Clinical diagnosis: uterine fibroid. Location: anterior wall of uterus. Microscopic diagnosis: malignant leiomyoma. Type III. Died 5 months after operation with recurrence.

CASE 18. Path. No. 8922. Date, May 4, 1918. Age 42, married. Clinical diagnosis: uterine polyp. Location: intra-uterine. Microscopic diagnosis: malignant leiomyoma. Type III. Result: still living, no evidence of recurrence.

CASE 19. Path. No. 9160. Date, June 7, 1918. Age 60, married. Clinical diagnosis: suspicious of malignancy. Location: uterine scrapings. Microscopic diagnosis: malignant leiomyoma. Type III. Result: still living, but evidence of recurrence. Bloody discharge.

CASE 20. Path. No. 9222. Date, June 12, 1918. Age 48, married. Clinical diagnosis: fibroid. Location: body of uterus. Microscopic diagnosis: malignant leiomyoma. Type II. Result: still living. Health fair. No evidence of recurrence.

CASE 21. Path. No. 9445. Date, July 11, 1918. Age 68, married. Clinical diagnosis: fibroid degeneration. Location: posterior wall of uterus, adherent to mesentery. Type II. Result: died 9 days after operation from pneumonia.

CASE 22. Path. No. 10064. Date, October 26, 1918. Age 47, married. Clinical diagnosis: carcinoma. Location: cervix and endometrium. Microscopic diagnosis: malignant leiomyoma. Type I.

It will be seen that in all the cases except one (21 out of 22), the patients were married women. This is somewhat above the normal relation of single to married women, which is usually estimated as 1 to 13, although it would be difficult to connect marriage with the etiology of malignant leiomyoma. The age incident varied from 32 to 72. However, 20 occurred between 40 and 65 and 8 of these were in the forties.

The clinical diagnosis received with the specimens varied greatly, an exact diagnosis not being made in any case, although 7 were described as "degenerating fibroids" and 5 others were diagnosed as malignant, carcinoma or cancer. Begouin states that an accurate diagnosis can only be made with a microscope, but that one should be suspicious of malignant change when bleeding and rapid growth are added to the symptomology of a fibroid.

While the majority of these tumors originated in leiomyomata, in some the tumor was said to have sprung from the body of the uterus, others from the cervix, and two were described as polyps. When a tumor has become well advanced it is not always easy to tell its exact origin. On two occasions we have found a malignant change in very small leiomyomata.

The relation of the various types to the number of our cases is as follows: Type I, three cases; Type II, eight cases; Type III, eleven cases. In discussing the end to which these conditions lead, we, of course, must take into consideration the fact that a number of cases are too recent to decide their outcome definitely. Our statistics show that two of the cases of Type I have remained well, one and two years respectively. Of the cases of Type II, four have remained well, two died soon after the operation and two died sometime later with evidence of recurrence. Out of the eleven cases of Type III, one remains well, 6 months having elapsed since operation, and one shows evidence of recurrence. Two died soon after the operation, while seven died from recurrences in periods varying from 6 to 11 months after operation.

The earliest authors described malignant tumors such as are included in this series under the general name endothelioma. Upon more careful study they were reclassified under the term myosarcoma, meaning a mixed tumor resulting from a true sarcoma arising from the interstitial connective tissue of a leiomyoma. Later many of these tumors were described as true malignant tumors formed from the smooth type of muscle cell and very frequently occurring in pre-existing "fibroids" but were considered relatively rare as compared to sarcoma. It would seem from the statistics of this laboratory that the common type of mesoblastic malignant tumor of the uterus is the malignant leiomyoma and that true sarcoma is an exceedingly rare tumor of the uterus.

We have divided malignant leiomyomata histologically into three types according to their variation from the smooth muscle type cell and believe that their malignancy is somewhat in accord with their histological type. It may be, however, that the division into types is purely artificial and only represents stages in the growth of the tumor, that is, the earlier the tumor is found the nearer it holds to the smooth muscle type of cell. In any event the tumors which we received that were large and broken down were usually of Type III.

It may be possible that Type I represents the borderline but there can be no doubt of the malignancy of the other types. In connection with the question of malignancy one may consider these tumors of a low form in their earlier stages for they have little tendency to metastasize, but in their later stages their power of infiltration is considerable and recurrence is the usual sequence of

their removal. It is well, also, to emphasize the warning of Geist that the treatment by X-ray or radium of "fibroids" is dangerous in women past 40 years of age, because if malignant change has taken place, this treatment is of no avail and valuable time may be lost.

CONCLUSIONS

1. Malignant leiomyomata are not uncommon.

2. They arise most frequently from preexisting leiomyomata.

3. The three histological types into which malignant leiomyomata may be divided apparently correspond with their degree of malignancy.

4. In view of the frequency of malignant change in fibroids we believe they should be removed surgically as soon as discovered.

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CLINICAL EFFICIENCY AND TERMINOLOGY IN CANCER OF THE BREAST[1]

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IN spite of the fact that cancer of the breast has been abundantly and excellently considered by the best authorities over a long period of years, there are some reasons why it demands renewed interest.

Besides the pathological facts there are four parties concerned, from the standpoint of efficiency, in dealing with this condition which is of such economic and humanitarian importance. Each party represents a different degree of opportunity to handle facts relative to diagnostic probability and certainty. The one with the least certainty and fewest facts is the patient, the one with the most facts and greatest certainty is the pathologist; the clinician and surgeon are the intermediaries between these two. Perhaps this statement will not be accepted immediately by clinicians and surgeons, both of whom in the absence of clinically inclined pathologists have, of necessity, been forced to assume the rôle of clinician and pathologist, the first and last courts.

A combined clinician, surgeon, and pathologist would be an ideal individual and such an one was possible a few years ago when clinical knowledge, surgical experience, and pathological facts were limited. Today each represents specialism in the field of medical science the many branches of which have grown to such proportions that no one individual can comprehend all clinical facts, perform efficiently all operations or master the subject of pathology completely. Each must know all of the facts upon his own subject and all must know enough of relationships to assist in the correlation of the knowledge of all specialists.

Since cancer of the breast starts as a microscopic condition for which no specific cure has been discovered, it possesses important significance long before it becomes possible for the patient, clinician, surgeon, or pathologist to recognize its presence by any known methods. From the standpoint of gross diagnosis of the early presence of the condition in the patient all parties deal only with probabilities which approach certainty usually in direct proportion to size of growth or its fixity to the skin or underlying muscles. Fixity, however, is not absolute as active clinicians, surgeons, and pathologists know.

[1] Presented for publication, January 29, 1919.

A comparative study of pre-operative clinical and pathological diagnoses reveals the following facts relative to the clinician's diagnostic relation to cancer of the breast in two large series:

	First Series		Second Series	
	Number	Per Cent	Number	Per Cent
Breasts removed	1800		300	
Positive pre-operative clinical diagnoses	1526	84.8	217	72⅓
Doubtful pre-operative clinical diagnoses	274	15.2	83	27⅔
Positive pre-operative diagnosis correct regarding malignancy or benignancy*	1146	75	199	91.7
Positive pre-operative diagnoses incorrect regarding malignancy or benignancy	380	25	18	8.3
Expressed positive diagnoses of malignancy correct regarding malignancy*	725	94.2	111	94.9
Expressed positive diagnoses of malignancy incorrect regarding malignancy or benignancy	44	5.8	6	5.1
Expressed doubtful diagnoses of malignancy correct regarding malignancy or benignancy	93	58	21	67.7
Expressed doubtful diagnoses of malignancy incorrect regarding malignancy or benignancy	68	42	10	32.3
Expressed positive diagnoses of benign conditions correct regarding malignancy or benignancy	421	91	91	86.6
Expressed positive diagnoses of benign conditions incorrect regarding malignancy or benignancy	41	9	14	13.4
Expressed doubtful diagnoses of a benign condition correct regarding malignancy or benignancy	10	77	13	86.6
Expressed doubtful diagnoses of a benign condition incorrect regarding malignancy or benignancy	3	23	2	13.4
Diagnoses of nodule, tumor, or mass, or no diagnosis	395	22	39	13
Of diagnoses of nodule, tumor, etc., malignant	69	17.5	7	17.9
Positive diagnoses of malignancy	769	42.6	117	39
Doubtful diagnoses of malignancy	161	8.95	31	10.33
Carcinomata diagnosed in laboratory	933	51.83	148	49.33
Carcinomata not diagnosed positively by clinician	208	22.3	37	24.2
Of malignancy the clinician diagnoses with certainty only	725	77.7	111	75
Of those not diagnosed positively the clinician has expressed suspicion in	93	44.5	21	57

*In the statistics above "positive diagnosis" means that the clinician merely made a general statement as to malignancy or benignancy and "expressed diagnosis" means that the clinician specifically stated his diagnosis as "carcinoma," "mastitis," etc.

Two series were studied for the purpose of determining statistically the elements of certainty and probability in clinical diagnosis from a terminological standpoint in relation to pathological facts and terminology. The first series of 1800 cases (10) represents the first 1800 cases and the second series the last 300 cases which have come under observation. The pre-operative diagnosis or instructions to the surgeons were made by clinicians whose experience ranged from 5 to 25 years and whose training had been obtained in the representative medical schools of the United States and Canada and, in some instances, the leading institutions of Europe.

From these studies the following generalizations may be made relative to actual clinical efficiency when endeavoring to differentiate all malignant conditions from all benign conditions in the breast:

	Second Series Percentage	First Series Percentage
1. General positive diagnoses are relatively fewer than formerly	72	84.8
2. Correctness of general positive pre-operative diagnoses is relatively greater than formerly	91.7	75
3. Specifically expressed, positive diagnoses of malignancy remain practically the same	94.9	94.2
4. Expressed doubtful diagnoses of malignancy are more correct than formerly	67.7	58
5. Correct, expressed, positive diagnoses of a benign condition remain about the same	86	91
6. Expressed doubtful diagnoses of a benign condition are more frequent than formerly	86.6	77
7. Diagnoses of "tumor," "mass," "nodule," or "no diagnosis" are fewer than formerly	13	22
8. Of all breast conditions the clinician makes a positive diagnosis of malignancy in about the same percentage	39	42.6
9. Operable carcinomata occur in about the same relative frequency	49.3	51.8
10. The clinician makes a doubtful diagnosis in all carcinomata more frequently than formerly	21	17.2
11. His specifically expressed diagnosis of malignancy remains about the same	75	77.7
12. Of those cases of malignancy not positively diagnosed he expresses a suspicion in a greater percentage than formerly	57	44.5
13. Out of the last 300 breasts operated upon, 21 or 7 per cent were submitted to the laboratory for diagnosis before the complete operation was performed		

Although these figures vary slightly from time to time the fundamental facts relative to diagnostic certainty remain the same. Clinicians and surgeons are dealing with fairly definite percentages of certainty and probability, the former of which will become less and less as the layman and clinician become educated to the recognition of pathologic although indefinite conditions.

The factors of uncertainty in clinical and even gross diagnosis are emphasized in the following statistics which show the necessity of microscopic diagnoses after specimens have been removed from the body:

Total number of general pathologic diagnoses recorded between August 1, 1917, and December 1, 1918, 11,236.

Percentage of diagnoses which were of necessity microscopic, 21.8 per cent.

The breast presents a smaller figure for necessary microscopic diagnosis than do general specimens, the former being 13.3 per cent.

The efficiency of pathologic terminology when utilized as clinical terminology in diagnosticating mammary conditions is seen in the following list of positive pathological mistakes which occurred in the series of 1800 cases:

Pathological Diagnosis	Clinical Diagnosis
Diffuse lipoma	called chronic mastitis
Cyst	called fibro-adenoma
Fibro-adenoma	called adenoma
Fibromyxoma	called carcinoma
Adenofibroma	called fibro-adenoma
Fibro-adenoma	called retention cyst
Fibro-adenoma	called adenofibroma
Adenofibroma	called carcinoma
Fibro-adenoma	called fibroma
Cystic fibro-adenoma	called myxoma
Adenofibroma	called chronic mastitis
Cystic fibro-adenoma	called chronic mastitis
Cysts	called carcinoma
Cysts	called chronic mastitis
Fibro adenoma	called chronic mastitis
Intracanalicular fibroma	called carcinoma
Lipoma	called cyst
Papillary fibrocystadenoma	called cystadenoma
Cyst	called adenoma (early carcinoma)
Fibro-adenoma	called cystadenoma
Cystadenoma	called adenoma
Adenofibroma	called fibroma
Intracanalicular papilloma	called chronic mastitis
Intracanalicular fibro-adenoma	called fibroma
Fibrolipoma	called chronic mastitis
Intracanalicular fibro-adenoma	called adenoma
Adenofibroma	called cystadenoma
Fibrocystadenoma	called adenoma
Intracanalicular fibro-adenoma	called fibro-adenoma
Intracanalicular fibro-adenoma	called chronic mastitis
Myxoma	called neuroma
Intracanalicular adenofibroma	called fibroma
Cyst	called adenoma
Adenomyxoma	called adenoma
Lipoma	called fibroma

In the same series of 1800 specimens the following pathological names were applied by the pathologists to the conditions found.

Adenofibroma	[1] Adenofibromyxoma
Adenoma	[1] Adenomyxoma
[1] Adenomyxofibroma	Benign
[1] Angioma	Cyst

[1] Pathologic terms not utilized by the clinician.

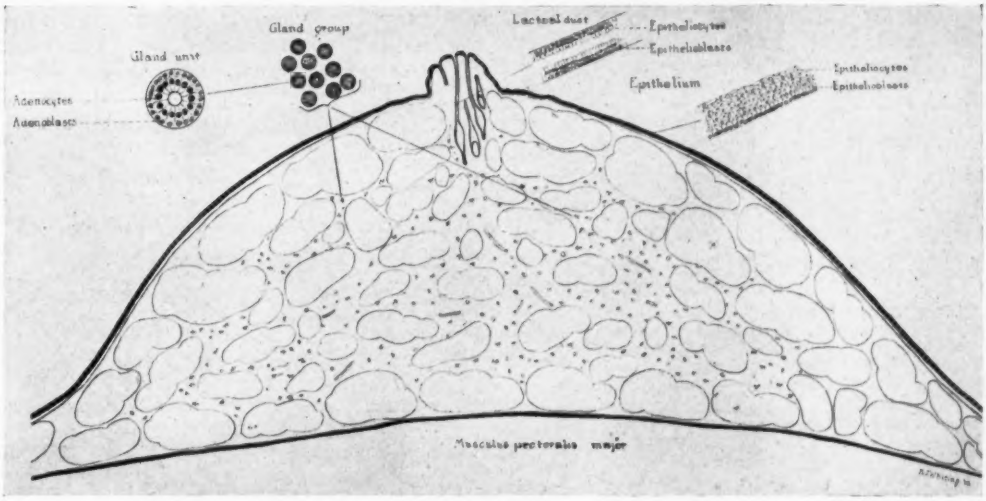

Fig. 1. Diagram of breast showing the specific mammary tissues, i .e., epitheliotex of the skin, modified epitheliotex of the ducts and the adenotex of the acini.

[1] Cystic fibroma
Cystadenoma
[1] Chondrolipofibroma
Cystic fibro-adenoma
Cystic adenofibroma
[1] Calcareous tumor
Chronic mastitis
[1] Cystic intracanalicular papillary adenofibroma
[1] Calcareous adenoma
[1] Cystic calcareous fibroma
[1] Calcareous intracanalicular adenofibroma
Carcinoma
[1] Dermoid
[1] Embryoma
Fibro-adenoma
Fibroma
Fibromyxoma
[1] Fibrolipoma
[1] Fibromyoma
[1] Fibrocystadenoma
[1] Fibromyxo-adenoma
[1] Intracanalicular myxoma
[1] Intracanalicular fibroma
[1] Intracanalicular fibro-adenoma
[1] Intracanalicular adenofibroma
[1] Intracanalicular papilloma
[1] Intracanalicular fibro-myxoma
[1] Intracystic papilloma
[1] Intracanalicular myxofibroma
[1] Intraductal papilloma
[1] Intracanalicular adenomyxoma
[1] Intracanalicular fibroadenomyxoma
[1] Intracanalicular papilloma (malignant)
Lipoma
[1] Myxofibroma
[1] Myxofibro-adenoma
Myxoma
[1] Myxo-adenofibroma
[1] Papillary cyst
[1] Papillary fibro-adenoma
[1] Papillary fibro-cystadenoma
[1] Pericanalicular fibroma
Sebaceous cyst

[1] Pathologic terms not utilized by the clinician.

The clinician, however, applied the following more limited list of names, a fact which shows his own recognition of his inability to diagnosticate in terms of pathologic terminology:

Adenoma
Adenofibroma
Lipoma
Benign
Cyst
Carcinoma
Chronic mastitis
Cystic fibro-adenoma
Cystadenoma
Cystic degeneration
Fibroma
Fibro-adenoma
Sarcoma
Fibromyxoma
Growth
Lipoma
Lump
Myxoma
Mass
Malignant
Nodule
Neuroma
No diagnosis
Papilloma
Placque
Retention cyst
Sebaceous cyst

The terms utilized by both the clinician and the pathologist represent their code of communication of ideas which has been culled out of many textbooks and articles which have come to them during their medical training or during their experience as practitioners. In view of the fact that there has been no uniformity of code utilized by the many practitioners with whom we have been associated, the question of economic and scientific efficiency of our present pathological terminology has become one of importance.

The following lists of pathological terminology have been obtained from such standardized texts as those of Kaufmann (5), Adami (1), Delafield and Prudden (3), Hertzler (4), Aschoff (2), Ziegler (12), and MacCallum (6). In these lists all pathological conditions are named and listed

because all conditions must be differentiated from malignant conditions of which carcinoma certainly is the most prominent.

KAUFMANN

Parenchymatous mastitis
Infectious mastitis
Mastitis infectiosa parenchymatosa
Mastitis infectiosa interstitialis
Chronic mastitis (mastitis chronica cystica)
Cirrhosis mammæ
Cyst
Maladie cystique de la Mamelle (Reclus)
Cystadenoma
Polycystoma
Intracanalicular cystadenoma
Mastitis tuberculosa obliterans
Mastitis gummosa
Lipomatosis
Adenoma
Fibro-adenoma
Adenofibrosum
Adenofibroma
Fibro-epithelial tumors
Adenomyxoma
Adenosarcoma
Fibroma
Myxoma
Sarcoma
Adenosarcoma
Fibro-adenoma acinosum
Fibro-adenoma tubulare
Fibroma pericanaliculare
Plexiform fibroma
Pericanalicular fibromyxoma
Fibro-myxo-sarcoma
Fibro-adenoma cysticum
Intracanalicular fibroma
Intracanalicular myxoma
Intracanalicular sarcoma
Fibroma intracanaliculare mammæ œdematosum
Cystosarcoma
Cystosarcoma phyllodes
Fibroma proliferum or arborescens
Myxoma proliferum or arborescens
Sarcoma proliferum or arborescens
Fibroma, Myxoma, Sarcoma } Papillare or polyposum intracanaliculare
Cystadenoma papilliferum
Intracanalicular cystadenoma
Cystic papillary epithelioma
Papillary cystocarcinoma
Papillary epithelioma (cylinder cells)
Papillary carcinoma
Fibromyxoma
Myoma
Myofibroma
Cavernous hæmangioma
Enchondroma
Osteoma
Osteochondroma
Lipoma
Small round cell sarcoma
Spindle cell sarcoma
Polymorphic cell sarcoma
Giant cell sarcoma
Angiosarcoma
Endothelioma
Chondrosarcoma
Osteoid sarcoma
Sarcocarcinoma
Chondrosarcocarcinoma
Carcinoma chondrosarcomatosum
Cystic papillary adenocarcinoma
Paget's disease
Carcinoma solidum
Adenocarcinoma
Flat cell carcinoma
Carcinoma solidum simplex
Tubular carcinoma
Acinous carcinoma
Carcinoma solidum medullare
Carcinoma granulosum
Carcinoma solidum scirrhosum
Cancer atrophicans
Medullary carcinoma
Carcinoma simplex
Psammocarcinoma
Carcinoma colloides
Carcinoma gelatinosum
Carcinoma cysticum
Carcinoma cylindromatosum
Adenocarcinoma cylindromatosum
Cystocarcinoma papillare
Cystocarcinoma simplex
Cystocarcinoma papilliferum
Carcinosarcoma
Carcinochondrosarcoma
Polycystoma
Cancer en cuirasse
Cyst
Involution cysts
Galactocele
Dermoid cyst
Epidermoidal cyst

ADAMI

Angineurotic œdema forming lumps in breast
Retromammary abscess
Acute mastitis
Puerperal mastitis
Diffuse mastitis
Interlobular mastitis
Acute galactophoritis
Chronic mastitis
Cirrhosis mammæ
Mastitis carcinomatosa
Acute miliary tuberculosis
Discrete tuberculosis
Confluent tuberculosis
Chancre
Gumma
Diffuse mastitis (syphilitæ)
Actinomycosis
Cyst
Hypertrophy
Diffuse hypertrophy
Cystadenoma
Retention or simple cyst
Adenoma
Fibroma
Adenofibroma
Fibro-adenoma
Adenomyxoma
Adenosarcoma
Mxyo-adenoma
Sarco-adenoma
Lipoma
Myxoma
Myoma
Angioma
Osteoma
Chondroma
Epithelioma
Carcinoma
Sarcoma
Plexiform fibroma
Pericanalicular fibroma
Periglandular fibroma
Intracanalicular fibroma
Fibroma cysticum
Cystadeno-fibroma intracanaliculare
Adenocele
Cholesteatoma
Adeno-acinosum
Adenoma tubulare
Solid sarcoma
Cystic sarcoma
Angiosarcoma
Perithelioma malignum
Melanotic sarcoma
Round cell sarcoma with striated muscle
Cystosarcoma phyllodes
Squamous epithelioma
Paget's disease
Malignant papillary dermatitis
Superficial carcinoma of skin
Acute miliary carcinosis
Scirrhous carcinoma
Carcinoma simplex
Carcinoma medullare
Adenocarcinoma
Cystic carcinoma
Cancer atrophicans
Encephaloid carcinoma
Carcinoma gelatinosum
Cystadenocarcinoma
Cancer en cuirasse
Panzerkrebs
Echinococcus cyst
Dermoid cyst
Cysticercus
Galactocele

DELAFIELD AND PRUDDEN

Paget's disease
Suppurative mastitis
Acute exudative mastitis
Tuberculosis of mamma
Chronic mastitis
Cystic hyperplasia
Syphilitic ulcers
Hypertrophy of mamma
Fibroma
Intracanalicular fibroma
Intracanalicular fibroadenoma
Pericanalicular fibroma
Myxoma
Osteoma
Chondroma
Osteochondroma
Lipoma
Myoma
Angioma
Adenoma
Papillary cystadenoma
Sarcoma
Carcinoma
Medullary carcinoma
Scirrhous carcinoma
Gelatinous carcinoma
Epithelioma

HERTZLER

Adenofibroma
Fibro-adenoma
Intracanalicular adenofibroma
Chronic interstitial mastitis
Senile parenchymatous hypertrophy
Schimmelbusch's disease
Tuberculosis
Mixed tumors
Cystic sarcoma
Adenosarcoma
Cystosarcoma
Sarcoma myxomatodes
Chondrosarcoma
Sarcoma phyllodes
Sarcoma
Lipoma
Papilloma
Myxoma
Angioma
Chondroma
Osteoma
Atheromatous cysts
Carcinoma
Scirrhous carcinoma
Medullary carcinoma
Encephaloid carcinoma
Carcinoma simplex
Carcinoma en cuirasse

Glandular carcinoma
Acute encephaloid carcinoma
Lactation cancer
Paget's disease
Colloid carcinoma

ASCHOFF

Fibro-adenoma
Fibro-adenoma pericanaliculare
Fibro-adenoma intracanaliculare
Adenomyxofibroma
Adenolipofibroma
Adenofibrosarcoma
Cystadenosarcoma phyllodes
Solid adenoma
Cystadenoma papilliferum
Involution cyst
Mastitis cystica chronica
Carcinoma
Carcinoma en cuirasse
Carcinoma medullare
Carcinoma scirrhosum
Psammo carcinoma
Colloid carcinoma
Paget's disease (epithelioma of nipple)
Melanoma
Fibroma
Sarcoma
Chondroma
Osteoma
Endothelioma
Perithelioma

ZIEGLER

Mastitis
Perimastitis
Cysts
Hypertrophy
Adenoma mammæ
Adenoma acinosum
Adenoma tubulare
Adeno fibroma
Fibroma pericanaliculare
Fibroma intracanaliculare
Adenocystoma
Adenocystoma papilliferum
Cystoma
Fibroma phyllodes
Sarcomaphyllodes
Adenomyxofibroma
Adenosarcoma
Endothelioma
Fibrosarcoma
Myxosarcoma
Intracanalicular fibrosarcoma
Adenocarcinoma
Lipoma
Angioma
Chondroma
Osteochondroma
Osteosarcoma
Cystocarcinoma mammæ papilliferum
Acinous cancer
Tubular scirrhous cancer
Cystocarcinoma
Carcinoma simplex
Carcinoma medullare
Carcinoma acinose
Carcinoma tubulare
Cancer en cuirasse
Paget's disease
Psammo carcinoma

MACCALLUM

Carcinoma
Paget's disease
Medullary cancer
Scirrhous cancer
Adenocarcinoma
Comedo cancer
Colloid carcinoma
Cancer en cuirasse
Chronic cystic mastitis
Adenoma
Adenofibroma
Intracanalicular fibro-adenoma
Intracystic papilloma
Intracanalicular myxofibroma
Mixed tumors
Sarcoma

The very fact that there is no definite uniformity in the pathologic terminology is evidence of the fact that pathologists themselves are not perfectly clear in their own minds relative to conditions which they attempt to handle, that is, pathological conditions in the breast. At least they have not gotten together in order to unify conceptions and terminology. This has led to great confusion for the clinician.

In view of the facts herewith presented relative to clinical diagnostic and pathologic terminologic efficiency it seems necessary to present a scheme of terminology which represents greater efficiency, not only from the standpoint of biopathological facts upon which the new terminology is essentially based, but also from the standpoint of clinical efficiency.

It is not necessary to review in detail the anatomy of the breast in order to state the fundamentals which underlie a simple conception of our subject. In so far as carcinoma, from which all other conditions must be differentiated and which represents the majority of malignant conditions, is concerned the breast consists of certain definite tissues; epitheliotex of the skin, modified epitheliotex of the ducts and sinuses and adenotex lining the acini which are the structural and functional mammary units (Fig. 1). Each of these tissues rests upon cells which have been demonstrated to be reserve cells for their regeneration. These reserve cells have been termed epithelioblasts and adenoblasts respectively (8). These three and these three tissues only and their respective regenerative cells are concerned in the question of carcinoma and epithelioma of this organ. Since epithelioma of the breast is a rare condition and presents itself as a superficial lesion which attracts attention early and is easily diagnosed, it is of little importance in comparison to the subject of carcinoma which is the main subject under consideration. We are interested, for the present, only in the modified epitheliotex of the ducts or tubules and the adenotex lining the acini with their respective regenerative cells.

For the sake of those of the profession who still rely upon their gross diagnosis it must be emphasized that these tissues are composed of microscopic cells and any changes occurring which involve a dozen or perhaps more of such cells would escape the notice of the most experienced gross pathologist although he might be assisted by a hand lens.

From a practical standpoint the question arises: What is the smallest carcinoma which can be positively recognized clinically? This is, in our experience, an unanswerable question because neoplasmata in the breast are associated with many variable conditions: some breasts contain much fat; others con-

tain little fat; some neoplasmata are near the skin or pectoral muscle and some are in other portions of the organ. There certainly is no point of selection for the development of such conditions. We know of nothing in a clinical history which will differentiate a carcinoma five millimeters in diameter from an encapsulated fibro-adenoma or a cyst of equal diameter. Multiplicity of lesions, while of some importance, is in no way positive because carcinomata are sometimes multiple, fibro-adenomata if multiple or single may also be associated with carcinoma, and cysts not infrequently are either associated with carcinomata or contain papillomata which are sometimes malignant. The best that a clinician can possibly do is to consider all possibilities. If he operates upon probabilities or what he considers certainties his error may, in a fairly definite number of cases, be one of too radical or one of insufficient operation or he may leave a carcinomatous condition in the rest of the breast.

If carcinoma were the only condition which arises in the breast our problems would be less difficult, but the fact that the organ consists of other tissues—fibro-tex, myo-tex, endothelio-tex, neuro-tex, and lipo-tex—complicates our relations to neoplastic possibilities. Each of these tissues and the adeno-tex of the ducts and acini are subject to benign and malignant conditions. These are the tissues which play rôles in any regenerative process. All other tissue cells, such as leucocytes, lymphocytes and erythrocytes which are found during this process are migrants coming to this organ through the blood stream.

Fundamental mammary tissues possess the power of regeneration, the degree of which varies with the tissue, myotex, and neurotex possessing the least, if any, regenerative power.

Regeneration rests in the reserve cells which have been called:

Epithelio-
Fibro-
Adeno-
Myo-
Endothelio-
Neuro-
Lipo- } blasts.[1]

[1] Endotheliocytes probably are so primitive that they are themselves endothelioblasts.

These cells react biologically in three degrees to any chronic destructive force or thing (7). The first reaction is hypertrophy, the second is hyperplasia, and the third is migration. These are fundamental biological reactions, manifestations of which produce microscopic, gross and clinical pictures, the recognition of which is dependent upon the efficiency of our natural and artificial instruments of observation.

The anatomical location of the biological reactions, their gross and microscopic structural manifestations, and their clinical behavior may be briefly expressed in Table I. (9):

TABLE I

Mammary	Encapsulated, Diffuse, Cystic, Intracystic, Extracystic, Ductal, Intraductal, Extraductal, Papillary	Primary, Secondary, Tertiary	Epithelio-, Fibro-, Adeno-, Myo-, Endothelio-, Neuro-, Lipo-	Cytoplasia With or without	Primary, Secondary, Tertiary	Differentiation[1]

[1] Differentiation has been divided into three degrees as follows:
First degree: The normal tissue alignment of cells.
Second degree: The normal tissue alignment of cells plus normal polarity of cells.
Third degree: The normal tissue alignment plus normal polarity plus normal morphological cyto-characteristics.

This terminology may be abbreviated in the following manner:

TABLE II

Mammo	Encapsulo-, Diffuso-, Cysto-, Intracysto-, Extracysto-, Ducto-, Intraducto-, Extraducto-, Papillo-	Primary, Secondary, Tertiary	Epithelio-, Fibro-, Adeno-, Myo-, Endothelio-, Neuro-, Lipo-	Cytoplasia	Primary, Secondary, Tertiary	Differentiation

If one desires to express the facts symbolically this may be done in the following manner:

Mammo.....	Δ Λ O Θ Φ T Π Ψ P Ω Σ	Primary / Secondary / Tertiary	ep fi ad my en ne li	Primary / Secondary / Tertiary	Differentiation

The Greek letters have the following symbolic meaning.

Δ Delta	=circumscribed or encapsulated.	T Tau	=ductal.
Λ lambda	=diffuse or non-encapsulated.	Π pi	=intraductal.
O omicron	=cystic.	Ψ psi	=extraductal.
Θ theta	=intracystic.	P rho	=papillary.
Φ phi	=extracystic.	Ω omega	=polyphoid.
		Σ sigma	=ulcerated.

This terminology deals only with tissue reactions coincident to regeneration of which neoplasia is but a phase. It does not attempt to express etiological factors. It is not expressive of the so-called inflammatory conditions, although in these, the most important consideration from the patient's standpoint is one of tissue regenerative reactions.

Such a terminological key (9) has served in our laboratories of surgical pathology to present accurately, simply, and briefly, the anatomical location, biological reactions, degree of biological reactions, and degrees of cellular differentiation from which facts more accurate clinical data can be inferred with greater simplicity than from any terminology with which the writers have had to deal.

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IRRITATION OF THE DURA

Or Inner Periosteum of the Skull[1]

By CASSIUS C. ROGERS, AM., M.D., F.A.C.S., Chicago

THE human body is divided into three great cavities: the abdominal, lined by its parietal and visceral peritoneum; the thoracic with its parietal and visceral pleura; the third, and one that interests us, the cranial with its dura and arachnoid. Anatomically the dura will be considered under two heads, the outer layer or true periosteum of the inner skull, and the inner layer or, as it may be properly called, parietal layer of the subdural space. Therefore we find the three cavities with similar linings.

The normal contents of the cranial cavity are all-important to life and paramount to man's duties and relations to society. To arrive at an intelligent prognosis it is important that the etiology of the intracranial lesions and the extent of the damage done be ascertained. The means of obtaining a comprehensive knowledge of the extent of the lesion and the assistance one can give to nature to restore these structures to a normal function is our object. It is my intention to limit my remarks to the periosteum commonly called the dura and the symptoms which the patient may manifest from irritation to this structure.

The cranial cavity normally contains just sufficient structures to fill it, and the slightest variation therefrom will produce symptoms.

The periosteum lining the inner skull is identical to and contiguous with the outer periosteum of the skull at all the foramina so that the skull is covered on its intracranial surface over its entire bony area, as there are no attachments of muscles or ligaments to the inner skull as we have on the outer surface. We are then to deal with the true periosteum and all the pathological conditions and complications to which the periosteum may be affected in any other part of the body.

The greatest part of the brain is not sensitive to pain and can be manipulated and explored while the patient is awake and conscious without producing discomfort. This is not true with the dura or periosteum. The rich nerve supply of the dura, the trochlear, ophthalmic, semilunar ganglion, vagus, hypoglossal and sympathetic nerves render it one of most sensitive structures in the body, and the slightest irritation produces agonizing pain. Its rich blood supply, the anterior meningeal from the ethmoid branch of the ophthalmic; the middle meningeal, viz., the great and small middle meningeal from the internal maxillary, the meningeal branch of the lachrymal and of the internal carotid and the meningeal branch of the ascending pharyngeal; the posterior meningeal, which arises from the ascending pharyngeal, the occipital and the vertebral, all are distributed to the dura or periosteum over the posterior cranial fossa (Santee.) This great volume of blood going to the dura or periosteum is sluggishly returned by way of the venous sinuses, making the dura or periosteum an easy prey for toxines that are carried in the blood stream. Again, by its proximity to the accessory sinuses it is readily inflamed or irritated when these sinuses become the seat of disease. The irritation of the dura or periosteum may be considered mechanical or infective, and these under the subheadings acute and chronic.

Under the acute would be considered depressed fractures with loose spiculæ of bone and foreign bodies, such as pieces of steel, bullets, etc. As these are readily diagnosed and the surgical interference is universally recognized, we will spend no time in considering them.

The chronic conditions, however, are well worth our consideration, as it is these that are frequently overlooked. The most frequent of these in my experience has been the deposit of lime salts in organized extradural or, strictly speaking, subperiosteal blood clots. After the acute hæmorrhagic condition subsides the patient may be apparently well for weeks, months, or even years before any localized symptoms manifest themselves. The symp-

[1] Read before the Chicago Surgical Society, February 6, 1919. (For discussion, see p.96.)

toms are pathognomonic and should be easily recognized. There is usually a history of a previous injury which may have been considered trivial by the patient at the time, and has long been forgotten until headaches appear, always localized in a definite area on the skull. The headaches may be constant, but more frequently are paroxysmal. They are exaggerated by bodily and mental fatigue, and are more frequent at night. They are agonizing, of gnawing, tearing character, and often associated with dizziness and vomiting. The pulse, temperature, and respirations may be normal and the blood count negative. During the attacks the cerebration is slow. The severity of the attacks may be epileptoid in character, and the patient may be mentally irresponsible for his acts and deeds. It is not infrequent for these patients to become heavy drinkers, using profane and most vile language during the seizures. They become adept liars and may resort to petty thievery. As the attacks become more and more frequent and severe, it is not at all unusual to find these cases declared insane and sent to sanitariums for treatment. It is true they act insane, but it is a pseudo-insanity due to a constant irritation and not to an actual brain lesion, as the insanity disappears after the removal of the irritant and the patient again becomes normal mentally in his acts and habits.

I will now cite the history of the first case of this kind upon whom I operated in 1907, or eleven-and-one-half years ago.

Mr. B., age 31, a laborer, married, father of two healthy children; family history negative. Several years previous to his illness he received an injury to the head which was considered slight. A physician was not called. Some years following the injury, while working for the Chicago Telephone Company and traveling from one side of the city to the other by means of a bicycle, he would complain of headache in the right frontal region, severe and localized to the size of a silver quarter. As the pain became more and more severe he would have lapse of memory, failing to return home after work, and while he was a temperate man at normal times he would frequently be found in saloons. He was once found in Iowa and had no recollection of how he got from Chicago. Another time he was found in Washington Park with his bicycle wrecked and he himself curled up under some bushes. He had no recollection of going from his home to Washington Park. He became unruly and vicious during the attacks. In 1907 he was trephined over the area of the previous injury, the area of the localized pain. When a bone plate two inches in diameter was removed the dura, or periosteum, was found to be covered for an area of one inch in diameter with lime salts giving the periosteum much the appearance and roughness of sandpaper. The bone was not replaced, the dura or periosteum not opened; the skin was sutured without drainage and the wound healed by primary union. The patient has not had an attack of pain or lapse of memory, he has not become intoxicated, since the operation and has held a responsible position ever since.

The report of a case similar to this, with an almost identical history and upon whom I operated in 1917, is given below.

Mr. P., age 35, American; family history negative. At the age of sixteen he fell from a building, striking his head upon a rock, which rendered him unconscious for about an hour. He managed to get up and go home. He was away from school for three days and was apparently slightly injured, and nothing more was thought of it for nine years, when he commenced to have dizzy spells, became nervous and irritable, with almost constant localized headache. He gradually grew worse during the next seven years, until 1915, when his headaches became so severe that the pain was unbearable. He became careless in his habits, neglected his business and his home and became a heavy and habitual drinker. In the summer of 1916 he became so unruly that he was sent to a sanitarium. In March, 1917, he was brought to the University Hospital. By the aid of stereoroentgenograms a depressed inner plate of the skull was easily demonstrable, with what was thought at the time to be a loose spicula of bone, but at the operation this was found to be a calcified subperiosteal blood clot; that is, the dura had the appearance and roughness of sandpaper. A plate of bone three inches in diameter that had been removed was not replaced. The entire area is now covered with bone, demonstrating the ossification function of the so-called dura, or a true periosteum. This man has not had a headache, has not drunk a drop, has not had a lapse of memory nor a "brain storm," since the operation, and is working every day.

I cite these two cases from a series of similar cases that I have operated upon, in all of which the results have been equally as satisfactory. There has been no operative mortality.

The second class of cases I wish to present comprises the acute, subperiosteal infections following infections of the accessory sinuses. The symptoms are so similar from all of the sinuses that we can classify them together. First, there is a history of a sinus infection.

As soon as the dura or periosteum becomes irritated there are characteristic symptoms that should tell one at once that the infection has gone beyond the sinus. The pain is increased and is exaggerated upon external pressure. The discharge from the sinus frequently becomes less. Often where there has been a temperature of 102 or 103° F., as soon as the dura or periosteum becomes irritated the temperature becomes normal or subnormal. From the irritation produced by the infection the dura or periosteum becomes œdematous, which causes intracranial pressure. I have previously stated that the cranial cavity is large enough to hold its normal contents only, and the slightest addition manifests itself by definite signs and symptoms. The pulse and respirations become slow and the blood pressure rises in direct ratio to the increased intracranial pressure. There may be a pathological leucocytosis, or the blood examination may be negative. There is projectile vomiting, usually associated with dizziness, and gradually mental symptoms appear. They are, first, indifference, second, slow cerebration, and, third, coma may develop. As this is an acute subperiosteal infection, and is liable to extend through the periosteum and inflame the soft structures, it may produce meningitis or brain abscess. This is all the more reason why the irritation or inflammation of the periosteum should be recognized early and treated as any acute, subperiosteal infection; that is, by relieving tension, thus arresting the progress of the disease. This can be done only by opening the skull, exposing the dura or periosteum, and thereby establishing free drainage. The dura or periosteum should not be opened. I will now present a case belonging to this class.

Mr. W., Hungarian, laborer, married, age 31. Six weeks before presenting himself at the University Hospital he complained of severe earache. Shortly afterward there was a discharge from the external ear. He went to a physician who irrigated the external auditory meatus, but his symptoms grew steadily worse. At this time a swelling developed back of the ear. He went to a second physician, who repeated the irrigations and gave him a syringe, telling him to wash out his ear at frequent intervals. His pain, however, did not subside. He went to a third physician, whose sign read, "Specialist in Ear, Nose and Throat." This "specialist" promised to cure him.

Treatment. Three leeches were applied back of his ear and he was given a hypodermic injection of vaccine, told to return in two days for another treatment, when again the leeches were applied and he received a second injection of vaccine. Two days later he complained of a terrible headache and vomited. When I saw him he had slow cerebration, no leucocytosis, normal temperature, slow pulse, increased blood pressure, and cerebral vomiting at intervals. I advised immediate operation, for I was confident the man had a mastoiditis that had extended to and was irritating the dura or periosteum. He was taken directly to the operating room. As soon as an incision was made through the skin and the outer wall of the mastoid antrum removed pulsating pus escaped in large quantities. The roof of the mastoid antrum was found necrosed and the granulated dura or periosteum presented itself. A plate of skull was removed above the mastoid process so as to establish free drainage. The lateral sinus was exposed to the extent of two-and-a-half inches. The wound was left entirely open, with the dura or periosteum exposed. The patient was in a critical condition for two days, after which time he made a rapid and uneventful recovery.

The third case I wished to present was one of hypertrophic periostitis with necrosis of the skull following acute mastoiditis.

In 1912, the patient developed acute mastoiditis on the right side, followed by an extradural or subperiosteal abscess. After suffering from severe headaches for a year and half the mastoid was operated upon but the extradural abscess was overlooked. In 1915 she came to me; I reoperated upon the mastoid and drained the extradural abscess. The pain was relieved for some time but within eighteen months the pain returned repeatedly and I have operated upon her seven times for localized extradural abscesses in different areas of the skull. I have removed in all twenty-three and one-half square inches of skull. For the last 16 months she has been free from pain.

To establish a diagnosis in these cases we have carefully considered the history, complete laboratory and X-ray findings, and in the recent ones have had the benefit of the serologic localization test of Abderhalden. I wish to emphasize the fact that in the cases of cerebral irritation due to deposits of lime salts on the dura or periosteum, a flat X-ray plate is absolutely valueless. The only plates that can be relied upon are the stereoroentgenograms, and these must be made by an expert and at least three sets of plates should be made by concentrating the rays upon three different areas of the head. The flat X-ray plate will

not show the deposited lime salts when taken through the skull, as being independent of the bone, and it is only the stereos that will show that the deposit is not a part of the skull, but lies a short distance internal to it.

I want to state further that a set of stereo plates are useless unless there is some one to read and properly interpret the findings that have been produced upon the plate.

The serologic work as done at the Durand Hospital by Dr. Retinger has opened a new field in diagnosing and localizing brain lesions. In cases as above cited I believe this work will be of value and is fairly reliable and will become more and more beneficial as Dr. Retinger continues his research. But should it fall into the hands of the general laboratory worker, with careless and slipshod methods, it will fall into disuse and be thrown in the discard and science will be the loser. So let an attempt be made to keep this work in the hands of the conscientious, careful worker, as work of this kind must be done by an especially trained and extremely careful man.

THE SURGERY OF TENDON TRANSPOSITION WITH SPECIAL REFERENCE TO THE IMPORTANCE OF THE TENDON SHEATH[1]

By M. A. BERNSTEIN, M.D., Chicago

THE object of this paper is to show the results of some experimental work performed in connection with the surgery of tendon transplantation, or rather as it might be more correctly described, tendon transposition.

Before describing these experiments and their results, it will be well to glance at the evolution and present status of tendon surgery, its clinical results, as well as at some of the findings of experimental research work regarding tendon regeneration, so that we may be in a position to judge, how far the present-day procedures are susceptible to improvement.

A perusal of the literature of tendon transpositions appears to show a few points quite clearly: first, it seems a well-established and acknowledged physiological fact that under certain conditions a healthy tendon can take up the function of a paralyzed tendon; second, that this transference of tendon functions is surgically possible; third, that although the transposition of a tendon is a practical surgical procedure, the functional result that should follow does not always occur. Some operators get good results, others do not. Even the same operator's results are not so constant that any method can be relied upon to give fairly uniform results as in other generally accepted operative procedures. Therefore, tendon transposition surgery, is viewed, by surgeons generally, with a certain amount of distrust, as there is too high a percentage of functional failures. The deduction from this would appear to be that failure to secure uniformly good function is either due to faulty technique or to an inexact knowledge of the limits and indications of tendon transpositions. We also note on reviewing the literature that until recently very little attention has been paid to the finer anatomy and physiology of the structures involved in tendon transpositions. The pathology is fairly well established, but the technique of operative procedures does not appear to have profited from it so as to avoid conditions which obviate the final success of carefully executed operations.

SURGICAL TRANSPOSITIONS OF TENDONS. METHODS

Although the fact that tendons could be surgically transposed and function was known and practised as early as the middle of the 17th century, yet the modern procedures date from 1880, when Nicoladoni (1) made the first deliberate transposition of a tendon for the treatment of infantile paralysis. Nicoladoni's method was anastomosis of a healthy to a diseased tendon, both being stripped from their peritendinous tissue. It was a partial method. His success encouraged

[1] From the Laboratories of the Northwestern University Medical School.

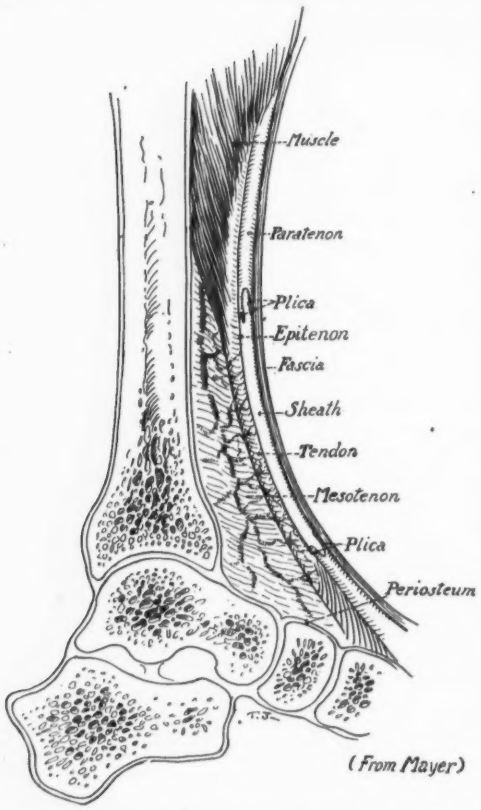

Fig. 1. Longitudinal section through the tibialis anticus muscle showing the peritendinous structure. (From *Mayer.*)

a number of imitators. In 1893, Drobnick (2) suggested and practised the transfer of the whole healthy tendon and its direct periosteal implantation, but he did not necessarily or usually make the new periosteal implantation in the old implantation site. This method was perfected by Lange (3) in 1899. Lange also used silk strands which were sutured both to the tendon end and to the periosteum, to make up for deficiency in the length of the transposed tendon. This was based on some experiments by Gluck (4) as far back as 1882.

These two methods, the anastomosis of Nicoladoni and the periosteal direct implantation of Lange, are the bases of all modern surgery of tendon transpositions. There have been many modifications. Wolff (5) made an osteal or subperiosteal bridge under which the tendon is slipped and sutured. Drobnick (2), in some cases, split a healthy tendon and attached one part to the paralyzed tendon. Jones (6) also followed this method. Mueller (7) modified the bone duct excavation implantation of Wolff, drawing the tendon through the completely perforated bone. This is the transosseous method. Milliken (8) introduced anastomosis by partial and reciprocal grafting of the tendons. Biesalski (9) draws the healthy tendon through the emptied sheath of the paralyzed tendon and sutures it periosteally. Vulpius (10) has been the most ardent and consistent advocate of the Nicoladoni method, the technique of which he has perfected. Codavilla (11) in Italy, has also been a firm follower of this method in suitable cases.

All operators have claimed successful results for the various methods advocated.

The general criticism of these methods is (a) that in all of them, the healthy tendon (whether anastomosed to the diseased tendon or directly implanted in its new insertion) *is first isolated from its normal anatomic surroundings;* and (b) that the tendon with its surrounding structures is subjected to a greater or less amount of operative traumatism; (c) that but little thought is given to the importance of a tendon being reconstituted normally as regards its working surroundings or to the pathologic conditions that could and do arise as a result of the operative trauma and which interferes with the subsequent action of a transposed tendon or with its nutrition.

Many writers have called attention to the necessity of the operator having a clear conception of the anatomy and physiology of the tendon. Let us, therefore, briefly glance at this.

THE ANATOMY OF TENDON AND PERITENDINOUS TISSUES

If we take a longitudinal section of a tendon; its sheath and its peritendinous tissues, it will show the following structures or most of them (see Fig 1): (a) tendon itself; (b) mesotenon; (c) paratenon; (d) plica;

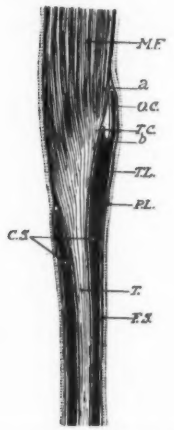

Fig. 2. Diagrammatic longitudinal section through the end of a typical synovial tendon sheath. (Modified from *Lowell* and *Tanner*.) *T.*, tendon; *M. F.*, muscle fibers; *F. S.*, fibrous sheath; *S. C.*, synovial cavity; *P. L.*, parietal layer of synovial membrane; *T. L.*, tendinous layer, corresponds to the epitenon; *O. C.*, osseofibrous cul-de-sac-plica duplicata; *T. C.*, tendinous cul-de-sac; *a.*, first reflection of parietal layer of synovial membrane—(superficial pocket of plica); *b.*, upward reflection of the same — deep pocket of plica.

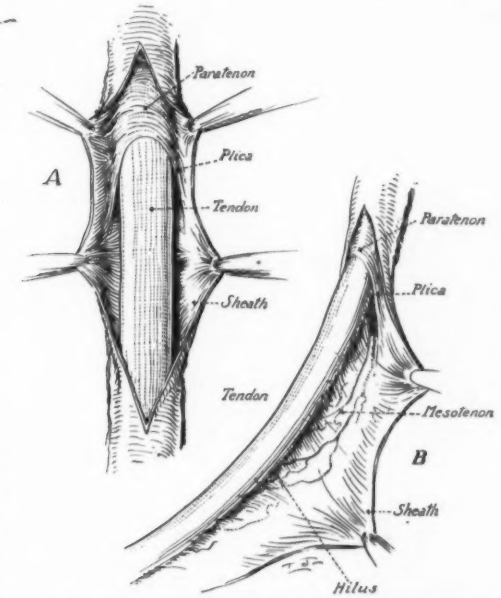

Fig., 3. Extensor longus hallucis tendon. Sheath is opened exposing the tendon and showing the finer anatomical structures. *A*, anteroposterior view; *B*, lateral view showing the mesotendon and hilus.

(e) the sheath; (f) epitenon. The tendon proper consists of longitudinal bundles of white elastic fibers. The bundles are separated by small connective-tissue septa, the endotenon or, as it is often termed, endotoneum internum, which is a dipping in of the outer covering layer of the tendon proper, the epitenon. The sheath is loosely applied around the tendon. It does not encircle it entirely as shown by Chemin (12), but somewhat in the same way as the visceral peritoneum covers the bowel. This sheath may be regarded as a bursa. It is generally found where a tendon changes its direction or where it passes under ligamentous structures. The inner surface of the sheath consists of a layer of cells which may be termed synovial; the outer surface consists of fibrous tissue and the two may be adherent or there may be a layer of fatty areolar tissue between the two. The sheath encloses a cavity filled with synovial fluid, acting as a lubricant for the tendon gliding through this cavity as well as a fluid buffer against injury.

Lovell and Tanner (13) made a study of the tendon and the peritendinous structures in 1907. They say that the simplest conception of the vaginal synovial membranes is that they are elongated synovial sacs into which the tendon is completely invaginated, a mesotendon being thus formed, connecting the visceral or tendinous layer to the parietal or osseofibrous layer. The synovial sacs have an independent origin. They are often continuous, either along the whole length of the sheath or at various points of it through the medium of mesotendons. A special arrangement is necessary to prevent rupture of the synovial membrane at the point where the tendinous and parietal layers become continuous at the end of the sheath. This arrangement is shown (Fig. 2) at *a* and *b* where the parietal layer of synovial membrane is twice reflected. The unattached portion of this layer gives plenty of play for the stretching or contracting of the tendon. This is the plica arrangement to which Biesalski and Mayer (14) refer in their more recent work.

When a tendon is exposed and lifted out of

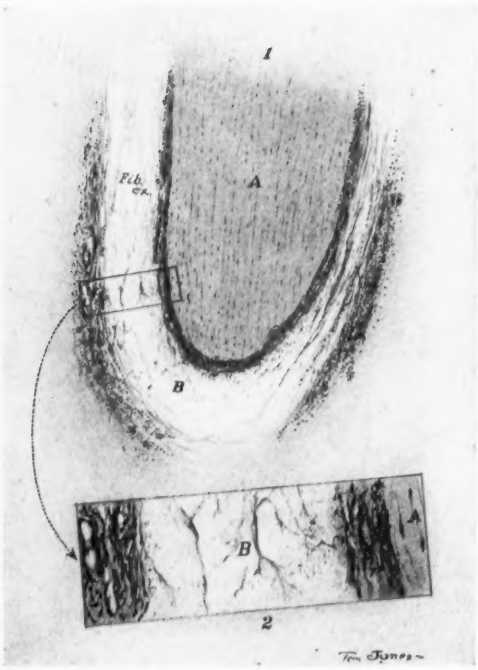

Fig. 4. Microscopic section of a transposed tendon through the sheath of another tendon of a dog; 21 days' duration. *A*, tendon, *B*, sheath. Notice the organization of the exudate with fibrous tissue formation in the sheath. In *B*, high magnification, is shown a proliferation of the sheath wall and the formation of new blood capillaries.

its sheath (Fig. 3), a loose delicate connective-tissue membrane is seen connecting the floor of the sheath with the tendon. This is the mesotenon. This structure is of the greatest importance as it is through it that the blood supply reaches the epitenon and endotenon. The blood supply is seen derived from branches of the vascular supply of the muscles, from the surrounding tissue as well as branches from the vessels running in the periosteum. These blood-vessels enter the mesotenon, ramify, anastomose, and spread over the epitenon and descend along the interfascicular connective tissue (endotenon) between the tendon bundles (Fig. 3). That part of the tendon in which the mesotenon is inserted is called the hilus.

Above the level of the sheath the tendon is surrounded by loose, fatty areolar connective

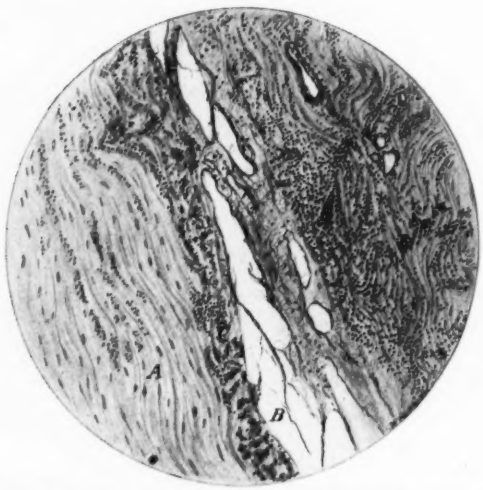

Fig. 5. This is a cross section of a transposed tendon through the sheath of another tendon; 2 weeks' duration, 16 objective, 2 oc. *A*, tendon; *B*, sheath; *C*, epitenon. Notice the inflammatory products filling in the sheath. Compare with Figs. 7, 8, 9.

tissue, through which the tendon glides. Mayer (15) has proposed the name paratenon, It is continuous with the paramesium of the muscle (Fig. 3). This areolar tissue still envelops the tendon when it enters the tendon sheath, but is soon reflected forming a fold, the plica, extending downward for some distance, and is attached first to the tendon and then to the sheath and moving up and down and wrinkling with them. The plica at its tendinous attachment may thus be said to be continuous with the epitenon. These paratendinous structures, as well as the mesotenon are highly elastic and easily stretch with each contraction and relaxation of the tendon without rupturing. They are of prime importance for the gliding mechanism of the tendon.

If a mesotendon is absent the blood supply to the tendon is carried through a fine membrane, developed at the two poles of the tendon and called the vincula.

The anatomical details briefly sketched here will be found given excellently in greater detail by Lovell and Tanner (13) and Mayer (15) and the authors quoted by them. They establish the physiologic importance of the

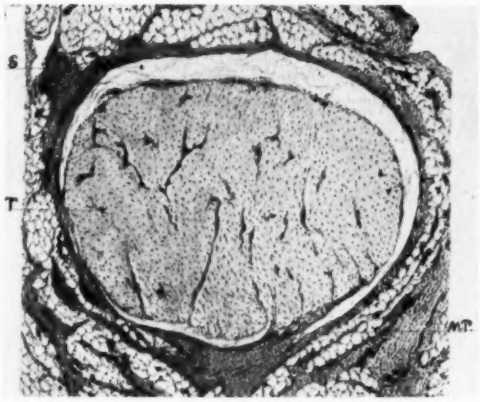

Fig. 6. Cross section through the transplanted tendon of the peroneus longus in its course through the sheath of the tibialis anticus, 17 days after operation. Leitz. obj. 1. Oc. 4. T. 160. In the cavity of the sheath are delicate connective-tissue strands—the result of the slight trauma incidental to the operation. They are sufficiently elastic not to impede the free gliding of the tendon. *S*, cavity of sheath; *T*, endotenon slightly hypertrophied; *Mt.* new formed mesotenon. (From *Mayer.*)

tendon sheath (1) in the gliding action and stretching of the tendon, (2) for the blood supply and nutrition of the tendon. A clear conception of these anatomical structures and of their physiological relations is of prime importance in the execution of surgical operations which involve the functioning of tendons as the integrity and their relationship must be preserved if we hope to achieve functionally successful results.

CLINICAL RESULTS OF TENDON TRANSPOSITIONS

Perhaps the best collective expression of opinion on the general clinical results of tendon transpositions by modern methods is that given at the 1907 *Congrès de Chirurgie*, at Paris. Most of the leading exponents of this class of surgery expressed their views based on a long experience; among them, Lange, Hoffa, Vulpius, Kirmisson, Jones, Mencière, Delagenière, Willems, etc.

Lange (16), in examining patients after tendon transplantation in which there was no return of function, found that this was due to adhesions between the transplanted tendon and sheath and surrounding tissues, which hindered movement of the tendon. In

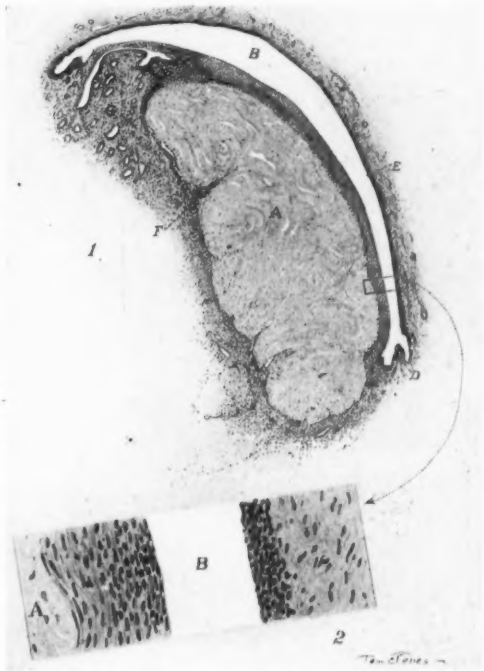

Fig. 7. Microscopic section of a transposed tendon, 21 days' duration. *A*, tendon; *B*, sheath; *C*, epitenon; *D*, plica; *E*, outer sheath wall; *F*, interfascicular connective tissue strands. Notice that the sheath is clear in spite of the proliferation and infiltration which has taken place. *B*, High magnification showing proliferation of epitenon. Notice to the left of the specimen the elongated synovial cells.

order to avoid these adhesions, Lange recommends transplanting the connective and adipose tissue surrounding the muscle and tendon and especially the tendon sheath, in order that the new peripheral adhesions should not be made on the tendon itself, but on the layers of tissue external to it which are soft and mobile. Lange thinks that the most important task is to learn how to avoid adhesions.

Jones (17) among the causes of failure, especially mentions rapid adhesions of the transplanted tendon, and insufficient liberation. In operating he preserves, if possible, the tendon sheath by making the least damage possible in the subcutaneous tissues.

Writers on tendon transplantation constantly refer to the occurrence of adhesions.

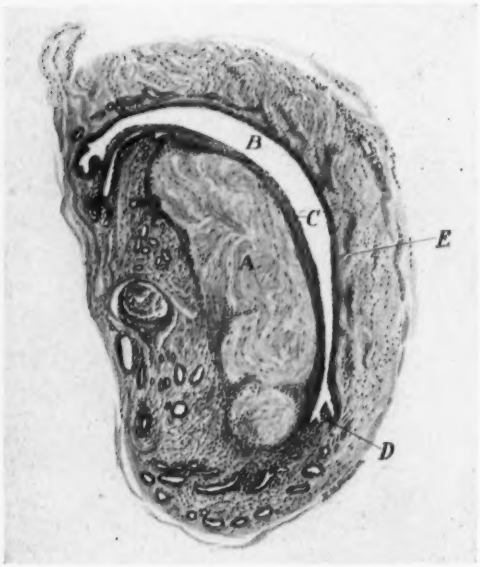

Fig. 8. Transposed tendon together with the sheath and peritendinous tissue, 2 weeks' duration. *A*, tendon; *B*, sheath; *C*, epitenon; *D*, plica; *E*, outer sheath wall-parietal layer. Notice that in spite of the slight infection the sheath remains free from inflammatory products and the formation of adhesions.

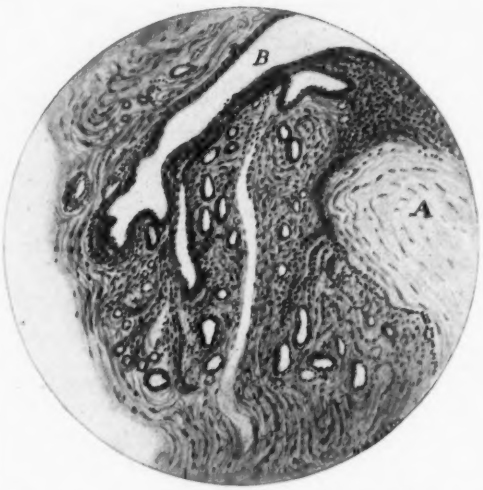

Fig. 9. 2 oc., 16 mm. objective. Transposed tendon together with the sheath and peritendinous structures, showing a more detailed view of the plica and its arrangement. *A*, tendon; *B*, sheath. Notice that the sheath is clear, the tendon is normal in appearance with some proliferation of the plica.

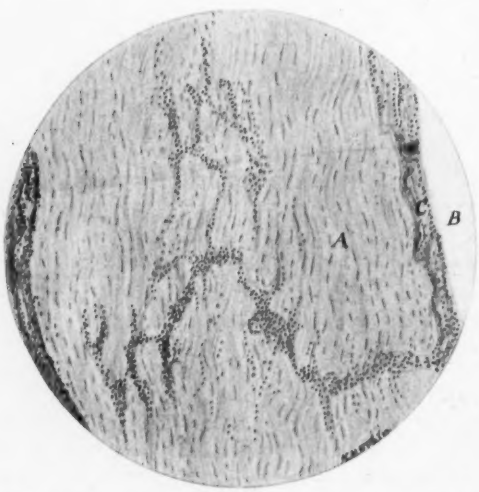

Fig. 10. Transposed tendon showing the extension of infection along the endotenon which contains the blood-vessels of the tendon. *A*, tendon; *B*, sheath; *C*, epitenon.

Biesalski (14) also attributes the unfavorable results after tendon transplantations to adhesions. His method of avoiding them and of obtaining good function, consists in drawing the transplanted tendon through the emptied sheath of the paralyzed tendon.

Kirmisson (18), who reviewed the results and statistics published up to 1907 and who besides has personal communications from leading orthopedic surgeons of the world in regard to tendon transplantations, finds that, although there was a general concensus on its value, yet there is a great difference of opinion between those who follow the tendon-to-tendon suture method of Nicoladoni and those who prefer the periosteal tendon suture of Drobnick-Lange. Both schools claim the best results and Kirmisson thinks that the question of technique ought to be definitely settled. Personally Kirmisson prefers the periosteal method, though his results have not been encouraging. He thinks that the real value of tendon transposition is still a matter to be determined. The whole question appears to be one of a satisfactory technique.

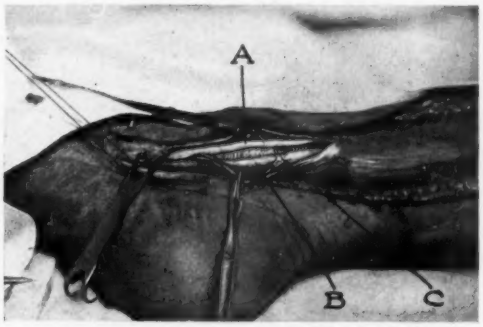

Fig. 11. Anatomical study showing the relation of the peroneus longus and brevis in the compartment common to both tendons behind the outer malleolus. *A*, perineus brevis; *B*, perineus longus. Notice the reflection of the lower portion of the sheath with the formation of a cul-de-sac, the plica at *C*.

Lovett (19), writing in 1910, thinks that the operative aspect of paralysis as exemplified in tendon transference overshadows other elements of treatment, and the neglect of the latter has led to a wrong conception of the operative value of tendon transference. The reason it has failed is because of unsuitably selected cases, insufficient after-treatment, and failure to correct deformities first. Adhesions are given as one of the causes of failure of operative technique.

Steindler (20) recently writes on the necessity of re-establishing the physiological conditions not only by mechanical reconstruction of the tendon but also by absolute preservation of the nutrition of the tendon. In the handling of tendons by the usual methods, much vital damage is being done. Steindler reconstructs the gliding mechanism of the tendon in accordance with the Biesalski-Mayer method, but in addition he preserves the meso-tendineum as the basis of tendon nutrition. He further asserts that secondary operations performed upon patients in whom tendon transposition was performed showed the tendons to have undergone fibrosis. This we believe was due to nutritional disturbance.

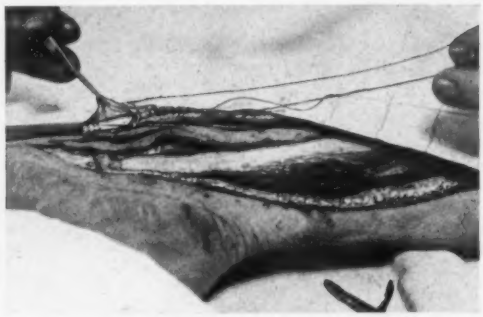

Fig. 13. Defect in sheath repaired with a continuous fine catgut suture encircling the tendon.

The conclusion that is fairly deducible from a study of the clinical results, appears to be that there is a general concensus of opinion that tendon transposition is a practical and valuable surgical procedure, but that none of the existing methods of performing it is entirely satisfactory as regards the functional

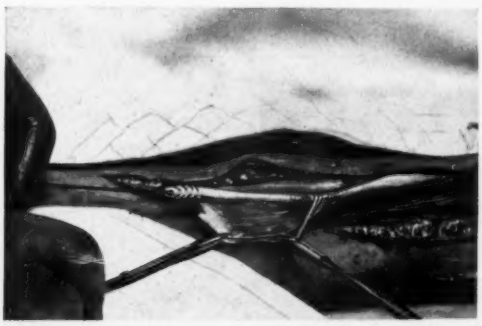

Fig. 12. Sutures inserted and peroneus longus severed from its insertion. Notice the cartilaginous appearance of lower portion of sheath and the amount of sheath carried over with the tendon.

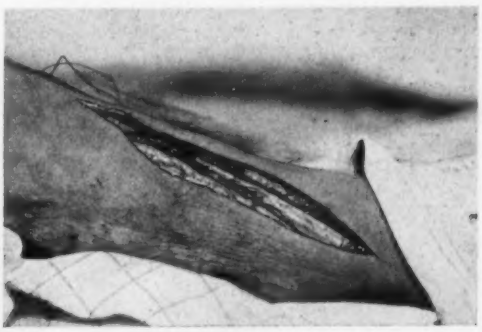

Fig. 14. Incision in the skin over the course of the transposed peroneus longus tendon showing the appearance of the tendon in its new position.

Fig. 15 Fig. 16 Fig. 17

Figs. 15, 16 and 17. The method of tendon transposition of peroneus longus to replace a paralyzed tibialis anticus. Refer to Figures 11, 12, 13 and 14 for the photographic illustrations for repair of the defect in the sheath.

end-results. It is also clearly seen that the occurrence of dense adhesions about the transferred tendon is one of the chief factors resulting from the operation which tends to make it a functional failure.

The questions as to the prior treatment of deformities and the postoperative treatment do not come within the scope of this paper which deals only with the operation of tendon transposition.

HISTOLOGICAL CHANGES OBSERVED IN THE TENDON STRUCTURES AFTER SECTION

The immediate (morphologic) changes in the tendon tissues following the section of a tendon have for a long time been the subject of experimental research. Pirogoff (21) as early as 1840, had called attention to the importance of extravasated blood in the repair process. He was followed later by Boner (22, 1957), Dembowski (23, 1869) and others who found that there was a rapid regeneration of tendon substance and expressed the opinion that the regeneration was dependent on the blood extravasated. The early experiments of Adams (24) and Paget (25) showed that this theory was wrong and that an infiltration of blood was not only unnecessary for repair, but *that it interfered with* rather than assisted the reparative process. Adams states that "the rapidity and perfection of the reparative process is directly proportional to the absence of both extravasated blood and inflammation." Adams showed also that this blood was responsible for adhesions which interfered with the function of the tendons. He drew particular attention to the importance of the tendon sheath as forming the matrix of the reparative material and directing the reparative process.

The importance of the tendon sheath in the reparative process of tendon repair and function was elaborated upon by Hartmann (26), Arcoleo (27), Seggel (28), Minervini (29), Borst (30), Menciere (31), Richardson (32), Silver (33), Sover (34), and others.

Arcoleo, who made a number of animal experiments regarding the value of the blood supply through the sheath in the nutrition of the tendon, found that the preservation of the sheath is necessary for the nutrition of the tendon. Removing the tendon from the sheath does not cause necrosis because the tendon partly derived its nutrition from the lymphatics.

Borst found that the repair of tendons was due to the emigration of leucocytes and proliferation of polyblast cells from the adjacent connective tissue. There was also a participation of true tendon cells.

Seggel's experiments showed that regeneration between the sutured ends of a tendon was much more rapid where the tendon sheath had been left intact. The sheath and adjacent connective tissues as well as the peritendineum externum and internum all contribute. Marchand (35) thinks that there are two processes; cicatrization and tendonization of the scar tissue.

Minervini studied all the literature on tendon regeneration up to 1903 and made independent experimental researches in the University of Genoa. His experiments comprised partial and complete tendon resections with separation of the stump and plastic operations to repair extensive losses of substance. From his own results and the findings of others, Minervini found that immediately in the focus of the lesion and in the sheath there was hæmorrhage, which coagulated at once. Soon round migrating elements and young proliferating cells infiltrated this coagulum which after 3 to 5 days is transformed into germinal or formative tissue and then into young cicatricial tissue which successively became fibrous. Adhesions to the sheath and to the integument which in the first days after the lesion was large, became circumscribed, with a tendency to lessen.

Soon after the lesion there is noted a general and diffuse reaction in the tendon, in the sheath and in the circumscribed tissues, consisting in vascular disturbances, clearly visible 12 hours after—hyperæmia, congestion, migration of leucocytes, and general proliferative activity. These processes reach their maximum by the third day. The endothelia of the tendon and of the sheath are among the first elements to proliferate. The fixed elements of the sheath and the connective tissue surrounding the tendon participate in this inflammatory re-

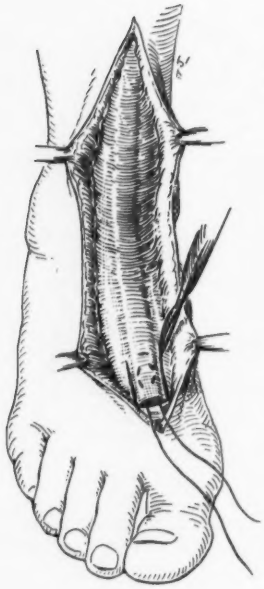

Fig. 18

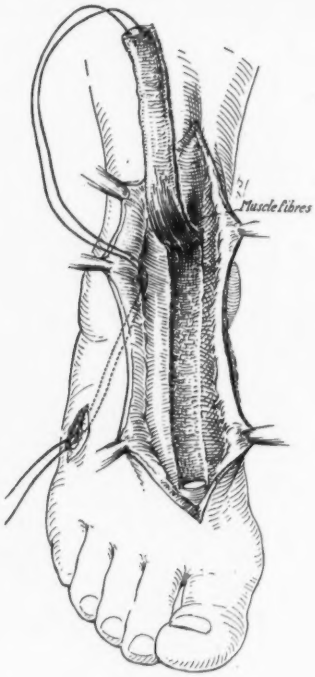

Fig. 19

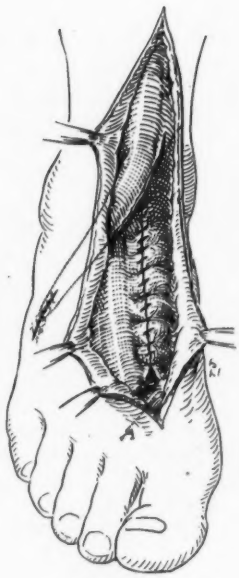

Fig. 20

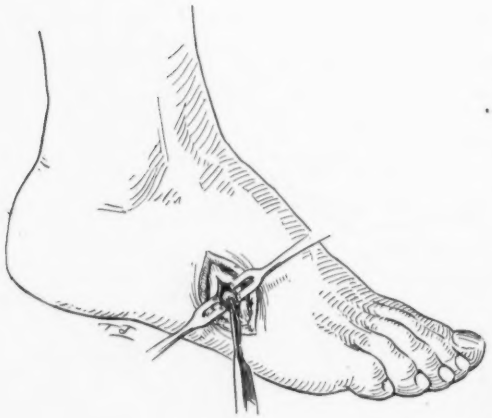

Fig. 21

Figs. 18, 19, 20 and 21. Method of transposing the extensor longus hallucis tendon for paralysis of the peroneus group. Notice in Fig. 21 the fixation of the stump of the extensor longus hallucis to the adjacent second phalanx. This is to avoid toe drop.

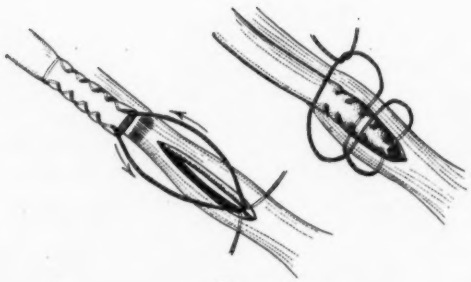

Fig. 22

Fig. 22. "Herring bone" stitch and method of insertion. Left hand drawing: Needle enters at outer third of the tendon and exits about one-half centimeter to inner side above; re-enters obliquely to about one-third distance and exits on surface of tendon; re-enters as above and continues to desired height, now passing through the tendon. The insertion of the needle is now reversed, entering from within out instead of from without in. The loops are now brought down to the split portion of the paralyzed tendon and one end of the suture is first introduced going through the tendon and periosteum, then the other end is inserted the same way. Right hand drawing: Tendon tucked into groove. Suture completed in figure-of-8 fashion and tied.

action. The process extends along the interfascicular septa and finally involves the tendon proper.

All the neoformed elements congregate in the lesion focus, and invade the coagulum, transforming it. Germinal tissue is rapidly organized and the young cells assume the shape of fibroblasts. The first neoformed capillaries have formed an evident network by the sixth to the eighth day. The tissue has taken on the form of a cicatrix. This tendon cicatrix does not show any traces of elastic fibers nor is the development of nerve fibers evident. The abundance of blood shed in the focus at first forms a kind of hæmatoma and hinders and delays the process of repair. In tendon plastics the process of the regeneration is the same, but slower. The germinal tissue is successively transformed into cicatrix and the progressive evolution up to the hundredth day is very similar if not identical with the tendon in structure. Adhesions of the tendon scar with the sheath and with the neighboring tendon, very extensive in the beginning, slow up in time. Cellular tissue alone finally remains which allows the tendon to slide. In the process of repair, it is observed that the sheath is ordinarily very active in partial resections and this activity increases as the distance between the tendon stump increases. Regeneration takes place in both tendon stumps, in the central end more intense, in the peripheral more early and active. The germinal tissue which gives place to the scar, is drawn rather from the *tendon stumps* than from the sheath and surrounding tissues; it is easily seen that the adhesions of the scar tissue to the sheath are very close and as a result the scar is long and subtle.

The researches of Mencière (31), Anzilotti (36), and Sever (34), tend further to establish the fact that when a tendon regenerates without the presence of a sheath, the neoformed tissue is fibrous, that in fact the presence of a sheath and peritendineum are necessary in order that true tendon tissue should be regenerated. Lange had previously found similar results. Sever especially showed that when these structures were present and functionated, early adhesions were absent.

Guaccero (37) also found experimentally that when the sheath was removed from a tendon the regeneration was fibrous.

Richardson's (32) experimental work as well as Minervini's confirmed the earlier work of Adams as regards extravasated blood interfering with healing and causing adhesions between the tendon and its sheath. He also found that it was most important that the tendon sheath and peritendinous tissues should be left as nearly intact as possible to prevent interference with tendon motion.

The researches of Silver (33) showed that when a reinforcing tendon is separated from its sheath and peritendineum in a transplantation, its function is interfered with by loss of nutrition.

Consideration of these experimental findings makes it quite clear that the function of a surgically transposed tendon *separated from its normal surrounding structures* is interfered with (1) by disturbances of its nutrition; (2) by mechanical obstructions to its motion, i. e. adhesions; (3) by a change in the nature of its regenerated tissue. As a corollary, it would seem that the true physiological method of transferring the function of a tendon to a new insertion is to transpose it *with all its necessary peritendinous structures and with the minimum amount of surgical traumatism.*

Having now given an outline of the present status of tendon transposition, surgical procedures and their results, I will pass to the special experimental work, the findings of which I desire to report.

EXPERIMENTAL RESEARCH ON VARIOUS MODES OF TRANSPOSING TENDONS

The experimental work carried out at the Northwestern University Medical School, was done with a view of determining the relations of the sheath to the tendon from a surgical standpoint. The experiments were divided into three series of tendon transpositions in dogs:

Series 1 (2 experiments). A tendon was sectioned at its insertion, lifted out of its sheath and surrounding tissues and transposed through the subcutaneous tissue into a

new peroisteal insertion. This is the Lange periosteal method.

Series 2 (8 experiments). A tendon was sectioned and isolated as above and transposed to its new insertion *through the sheath of another tendon*. This is the Biesalski-Mayer so-called, physiological method.

Series 3 (10 experiments). A tendon was sectioned at its insertion and transposed *together with its sheath* and *peritendinous tissue*. This is the author's method of transposition.

In executing these experiments, the strictest surgical precautions were observed, both as regards asepsis and the avoidance of unnecessary traumatism.

In my own method (Series 3) of transposing the tendon with the sheath and the peritendinous tissues, a special technique is adopted. After incision of the skin and superficial fascia, the skin is retracted and the tendon in its sheath exposed to view. *The tendon sheath is not opened.* Where two tendons occupy the same sheath as much of the sheath is carried over with the transposed tendon as is necessary to repair the defect. This is illustrated in Figures 11, 12 and 13 in the transposition of the peroneus longus. Special fixation sutures (Fig 22) are introduced at the point where the tendon is to be cut. After inserting the fixation sutures, an incision is carried laterally on both sides of the tendon for about one-fourth inch (Fig 6) and the tendon severed. The tendon, still in its sheath, is carefully raised by means of the fixation sutures, the special object being to avoid all possible trauma by handling, etc., and a scissors cuts *through the peritendinous tissue only* on each side of the tendon (Fig 15). The isolation of the tendon is carried to the lower muscle fibers. A probe is now introduced along the paralyzed muscle, taking into account the special anatomical relation of the septum which separates the adjacent muscles, viz., the fascial planes; the probe is then carried under the ligamentary structures, as for instance, the annular ligament, and brought out at the new implantation site. The fixation suture is now attached to the eye probe and carried down through the new canal. The transposed tendon is fixed in its new implantation. Throughout this entire operation the tendon is protected by its own normal coverings.

The period of immobilization varied from 8 to 21 days after operation. Microscopic sections were prepared from different levels of the tendon and the histological changes noted. In some cases the tendon was allowed to remain unattached. This was done to determine the viability of the sheath after transposition and was not intended to re-establish the function of the tendon.

The results found after these experiments were as follows:

Series 1. After 21 days the transposed tendon was deeply embedded in a granulating and infiltrating area. Microscopic sections at different levels showed marked leucocytic infiltration around the tendon bundles and penetrating along the endotenon into the tendon substance; some degenerative changes were shown in the tendon as evidenced by a poor staining reaction of the nuclei. The greatest amount of proliferation and infiltration took place in the epitenon and surrounding tissues, viz., a large number of leucocytes invading the structures surrounding the tendon with marked proliferation of the epitenon and numerous small new blood-vessels giving rise to the characteristic picture of granulating tissue.

Series 2. In the experimental transpositions of tendons through the sheath of another tendon (the Biesalski-Mayer method), the histological findings were very characteristic. Figure 4, microscopic section from a case of 21 days' standing, and Figure 5, one of two weeks' duration, show the tendon cells in an almost unchanged state, a few cells showing a slight œdematous condition. The sheath wall proliferated markedly; a marked leucocytic infiltration is evident. New blood-vessels are evident and filled with red blood corpuscles and leucocytes; in the sheath fibrinous adhesions are found extending from the tendon to the sheath wall and in places becoming incorporated with the sheath wall.

Series 3. Figure 7 is a 21 day cross-section through the extensor longus hallucis of a dog, operated upon by my method, and Figures 8 and 9 are specimens of two weeks' duration showing the following: (a) tendon, (b) sheath,

(c) plica duplicata, (d) epitenon, (e) endotenon. The tendon appears clear and unchanged. The sheath is clear in spite of infection which has taken place around the transposed tissue. The parietal surface of the sheath shows a leucocytic infiltration, with many mitotic changes. The basement membrane cells show a proliferation, but no breaking down into the sheath itself. Numerous young blood-vessels are visible and the process is clearly in the stage of regression. (Fig. 9.) The plica is thickened, but no breaking down of cell structures is discernible. The epitenon remains unimpaired as does the endotenon.

DISCUSSION OF EXPERIMENTAL FINDINGS

Series 1. The proliferative and infiltrative changes observed *when an exposed tendon is transposed directly to a new insertion* would lead one to believe that these changes are permanent; and although not marked enough to destroy the vitality are such as might interfere with the functioning of the tendon.

The extensive inflammatory reaction found around the tendon is only what may be expected, seeing that the tendon covering (epitenon) is synovial in character. When this tissue is placed subcutaneously in a traumatized area it responds extensively to inflammatory changes. It is impossible to conceive how a tissue so specialized as the peritendineum externum could remain uninvaded even under slight operative traumatism; this is intensified because the tendon itself has a comparatively poor blood supply, and it is removed from part of this, its normal source of nutrition, i. e. from the peritendinous tissue and mesotendon. The adhesions are greater because the tendon must re-establish its circulation from some other source. Lewis and Davis (38) state that when a tendon is transposed into subcutaneous fat, an infiltration takes place as well as proliferation referable to the epitenon and endotenon; there is also œdema probably due to imperfect restoration of the circulation.

Even when the tendon is transposed with its sheath, it appears that the greatest proliferation takes place in the sheath wall, as it is the characteristic of all synovial tissue to respond to stimuli by a proliferative and exudative reaction. Transposing a tendon to a new insertion stripped of all its surrounding tissues therefore appears to be unphysiologic, because (1) it deprives a tendon of its nourishment and (2) it exposes a susceptible tissue to irritation and thence to the formation of adhesions.

Series 2. In discussing the findings in these experiments in which the tendon was transposed through the sheath of another tendon, we must recall the anatomical relation of the tendon to the sheath, and the technique of the operation, in order that we may be better able to interpret the pathologic sequence. In this method the tendon sheath is opened and the tendon severed from its surrounding tissue (mesotenon, etc.). Sutures are inserted in the distal end. This forms a more or less thick rough stump. The tendon is now forced through the sheath of the paralyzed tendon. It is obvious that such an operation cannot be performed without some injury both to the tendon covering and to the new sheath The delicate epitenon is irritated and lacerated in places; there is a similar trauma of the sheath wall due to the rubbing of the tendon stump as it passes through this new canal. Referring back to the anatomical structure of the sheath (Figs 1, 2 and 3) it is seen that it is attached to the surface of the tendon (Fig. 3. mesotenon, plica). This connection must of necessity be torn in this technique. The plica as already noted is of special importance for the gliding action of the tendon. In order to expose and transplant the tendon, all the fine anatomical points which the advocates of this method have employed, must be sacrificed. The mesotenon, which structure is of prime importance for the nutrition of the tendon, is cut in order to free the tendon from its sheath. The pathologic effects of these traumatizing actions are seen in the inflammatory results which follow this procedure. The sheath becomes congested and as a result an increased amount of blood is brought to its surface. There results, therefore, an exudate of serum into the sheath with an infiltration of the sheath wall and surrounding tissue. The sheath wall may break down and the inflammatory products find their way along the interfascicular connective tissue.

Thus we see a fibrinous exudate in the sheath cavity, the meshes of which contain synovial cells, blood cells, and leucocytes; the pathologic picture resembling that of a tendovaginitis. When early motion is permitted, after this operation, the irritation produced by the constant playing of the tendon causes the reaction to continue. Such an affect is a contra-indication, therefore, for early active motion, which is a desideratum in this operation. The further progress which may be observed, takes two courses: (1) an absorption of the products of the inflammatory reaction; and (2) organization with fibrous tissue formation. Adhesions when they occur are a result of incomplete absorption of inflammatory products and it is seen from Figures 4, 5, and 6 that adhesions do take place. And although these adhesions become elongated by the constant play of the tendon, they still limit its motion. There are two types of adhesions here as elsewhere in synovial structures; they are at first fibrinous and elastic and later become fibrous and firm. Figure 6 is taken from Mayer. One can see "that in the cavity of the sheath are delicate connective-tissue strands, the result of slight trauma incidental to the operation." He, Mayer, is of the opinion that "they are sufficiently elastic not to impede the free gliding of the tendon." But it must be acknowledged with all respect to Mayer's method that if we are to accept an operative method it must fulfill the purpose for which it was intended, and if adhesions do form after this method, the result defeats its purpose.

The final results obtained therefore, by transposing a tendon through the sheath of another tendon, while an improvement on the older methods of direct transposition, cannot be considered as entitling this method to be physiologic as claimed for it.

Series 3. Very little comment is necessary as the results in this series are shown by the histologic findings. Figures 8 and 9 speak for themselves. The central fact is the absence of all inflammatory processes between the tendon and the sheath, and further there is no opportunity for the occurrence of adhesions. The epitenon and endotenon remain unimpaired. Such reaction as is observed has very little effect on the functional action of the transposed tendon.

The second important fact observed here is that this method of transposition avoids the possibility of fibrosis of the tendon, a condition which was observed in other methods. This fibrosis is a nutritional disturbance of the tendon and is brought about by separating the tendon from its blood supply, *mesotenon*, and its surrounding connective tissue structures.

Kirschner (39) does not believe that the epitenon possesses the reparative properties that the periosteum has; Richardson (32) is of the opposite view. The marked proliferative and infiltrative change which takes place along the septa strengthens one in the belief that Richardson is correct, and this view is in accordance with the experimental findings of other observers (Borst, Minervini, etc.). In inflammatory processes, the tendon parenchyma is passive, the inflammation, however, extends along the interfascicular connective tissue which carry blood-vessels (peritendinum internum-endotenon, Fig. 10.) The infiltration which follows extends along interfascicular connective tissue causing permanent fibrous changes. This accounts for the fibrosis of the tendon observed by many authors after direct transplantation, especially when the peritendinous structures were disregarded. It is obvious that when the peritendinous structures are transposed with the tendon such fibrosis cannot occur and experimentally it is so found.

This method of transposing a tendon, preserving with it its normal anatomical surroundings and obtaining results by which the tendon in its new position fulfills its normal functions, is therefore claimed as the true physiological method of transposing tendons.

The author desires to thank Dr. Allen B. Kanavel who has made this experimental work possible, also Dr. John L. Porter for valuable suggestions, Professor F. R. Zeit for interpretation of pathologic slides, and Professor S. W. Ransom for anatomical material used in connection with this work.

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GUNSHOT FRACTURE OF THE FEMUR

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FRACTURE of the femur ranks first in so far as difficulty in treatment is concerned. Because of the relatively large size of the thigh, it is impossible, except by open operation, to obtain and maintain reduction with the same ease and accuracy as can be secured in fractures of the smaller extremities. More frequently than in any other type of fracture, the end-results in our femur cases have been accompanied by some degree of permanent disability.

The man whose opportunity it has been to control the treatment of gunshot fracture of the femur subsequent to arrival at the base, will agree that no septic wound is more difficult to control than a deep intermuscular phlegmon of the thigh, particularly when caused by high explosive shell or shrapnel fragments. It is to the details of treatment of this type of fracture and to the exposition of a simple and highly efficient method of standardizing this treatment that I wish to write.

We must systematically begin the treatment of such fractures with several very definite objects in view, namely: immediate reduction and fixation; the earliest possible control of wound infection; ease of access to the thigh at all times for inspection and palpation; repeated X-ray control until bony union has occurred; a means easily of moving the patient without disturbing the fracture; and early and constant mobilization of the knee-joint.

It should be a cardinal rule that every fracture, regardless of its type or location, be reduced as quickly as possible, and permanent fixation applied. Mal-position of the fragments of a fracture traumatizes the soft tissues. This trauma within 48 to 72 hours manifests itself by œdema, by infiltration, and by a loss of the normal elasticity, which adds difficulties to the reduction. In compound fractures, this additional trauma to the soft tissues is frequently responsible for the further spread of infection.

There are two methods of immobilizing the fragments of any fracture. The first is traction; the second, some type of fixation splint or open operation. Overriding is an almost constant accompaniment of these fractures; neither plaster nor splints will correct this. Primary use of the Lane plate would certainly invite infection in the majority of cases. The chief indication for this method I believe is in those cases in which non-union occurs, and in which all wounds have completely healed. In cases suffering an active infection the use of a plate is out of the question.

Plaster of Paris has a very limited field in the treatment of any compound fracture of the femur. It is useful only in those fractures in the vicinity of the trochanter where there is no wound of consequence to care for, where there is no overriding, and where loss of abduction is the only deformity to be feared. Where there is any question of infection, plaster prevents that easy access for inspection to all parts of the thigh that is so necessary as long as an open wound remains.

We come now to methods of extension, which most certainly is the method of choice in nearly all compound fractures of the femur.

Buck's extension, its principle embodying the use of adhesive strips upon the skin upon which traction is made by means of weights and pulleys, is of course the method most commonly used. It is easily applied, is relatively comfortable, and in many cases it reduces the overriding, particularly in simple fractures. But there are a number of serious drawbacks to the routine use of Buck's extension.

First of all, it is not an infrequent occurrence to discover that no amount of pull that can be safely exerted upon a Buck's apparatus, will be sufficient to correct the overriding. We have made this observation by means of the X-ray upon fractures that had been under continuous traction for two weeks or more. This is due to the fact that much of the

pull does not reach the distal fragment of the femur, because it is lost in the intervening mass of thigh muscles. Fractures of the lower third are particularly hard to handle by this method because sufficient hold can not be obtained upon the lower fragment. For this reason it is often difficult to avoid undue pull upon the knee-joint in these cases; and one of the most disagreeable complications of a fracture near the knee is a stiff joint.

There is another serious objection to the use of adhesive for a compound fracture. While the wounds are open, it is often difficult to get enough sound skin to get a good purchase. Adhesive obscures too much of the thigh. Its presence near an open wound, particularly if suppurating, is often very uncomfortable.

As a method of traction, the Steinman pin or so-called nail extension offers an almost ideal means comfortably and safely of maintaining accurate apposition. The original method consists of driving a nail, one-eighth of an inch thick and some eight inches long, through the condyles of the femur, and making traction from the projecting ends. A more satisfactory modification consists of the "ice tongs" or "caliper," in which the nail on each side is driven merely through the compact bone of the condyles. The technique is as follows:

When it is not necessary to do other operative work upon the thigh requiring a general anæsthesia, the caliper may be attached under local anæsthesia. The site chosen is the most superficial point of the condyle on each side. A knife puncture down to the periosteum is made, the points of the caliper inserted, and then hammered into the bone about one-fourth of an inch. Care must be taken to avoid the knee-joint. A caliper with an adjustable set screw that prevents the points of the nail burrowing further, is advisable. The thigh is now ready for traction. This method of extension has the following advantages.

Traction upon the distal fragment is absolutely certain regardless of its length. Reduction is maintained with considerably less weight than is possible with adhesive. The entire leg and thigh are free from any other incumbrances necessary for traction. The thigh is readily held clear of the bed so as freely to expose the entire posterior surface without a supporting splint or counter-traction. The patient is entirely free from any discomfort due either to traction or to the wounds made by the nail punctures. These wounds when made through a clean area do not become infected.

There are two advantages in the use of the nail extension that are worthy of special mention. Permanent partial disability due to a stiff knee is of frequent occurrence following femur fractures, and probably the most common cause is an improperly applied Buck's extension. Continuous traction upon a normal joint will almost invariably produce a partial ankylosis. Furthermore, it is impossible in fractures close to the knee, to avoid excessive traction upon the joint when a Buck's extension is used. Moreover, simple immobilization of the knee often causes more disability than the fracture.

The use of the nail extension leaves the knee comfortably mobile from the moment of its application. It has been our custom to apply to the foot of the injured side a plaster shoe extending just above the ankle. A rope imbedded in the dorsum of the shoe leads upward over a pulley, and then down to within easy reach of the patient's hand. The shoe prevents foot-drop; by means of the rope he is able easily and frequently to flex and extend the knee. A most surprising feature of this procedure is its absolute painlessness; and it assures a joint with a full range of motion when bony union has occurred.

The second advantage of the method is its permanency for the particular fracture to which it is applied. It requires no change until a fair degree of union has occurred. A secondary operation for overlooked foreign bodies, for further drainage, or other cause does not necessitate the removal of or interference with extension.

We come now to the description of an adjunct to the above technique; namely, a method that makes the patient independent of his bed without disturbing his fracture. And if I seem to burden my description with unnecessary detail, it will have been more than worth while if I succeed in emphasizing

the necessity of these details. It is strict attention to minutiæ in these cases that minimizes wound complications, promotes a comfortable convalescence, which at best is long and tedious, and most important, prevents deformity.

In 1906, H. M. Richter suggested the use of a frame constructed of gas-pipe, similar in principle to the Bradford frame, for the treatment of fractures of the femur in children. The apparatus consists of a rectangular frame of gas-pipe corresponding in size to the margins of the bed. A Balkan frame of the same pipe is attached to each end of the rectangle by means of a sliding collar. The rectangle is covered by two pieces of canvas securely fastened to the sides, and separated in the center by enough space to allow easy access to the buttocks when the frame is lifted from the bed. The patient lies upon this frame, the canvas being covered, except for the space in the center, by sheets. Traction ropes from the nail extension are carried to pulleys fastened to projecting arm pieces.

Once so suspended, the patient may be lifted from the bed, washed, placed upon a bed pan, removed to the X-ray or operating room, without disturbing the relation of the fragments of his fracture, and without causing him pain. Confronted suddenly one night with ten suppurating compound fractures of the femur, we were quickly impressed by the necessity of having easy access to every wound during the time that the limb was in extension. After a preliminary trial with five or six cases, every femur fracture thereafter, was transferred to a frame, as soon as possible, after his arrival at the base.

We come now to the treatment of the wounds in these cases, a simple thing to describe, very often a most difficult feat successfully to accomplish. The present status of the treatment of soiled wounds may be summed up in a few words. Wherever possible, wound excision and primary closure is the method of choice, and is successful in more than 75 per cent of all cases. Vital structures, very extensive wounds, and poor operating facilities make excision impossible or dangerous. In these cases chemical sterilization makes possible in six to ten days a secondary closure that is practically equal in results to primary closure. It is in the latter class that Dakin's chloramine preparations find their greatest field of usefulness.

Thigh wounds offer special obstacles to the application of the technical details of these two methods of treatment. The large size of the thigh, the many fascial septa, and above all the great muscle mass are the chief causes of the difficulties.

The shattered femur causes an immediate shortening which makes it difficult to follow the path of the projectile. Moreover comminution is the rule, and it is a common occurrence to find fragments of bone several inches away from the site of the fracture. In addition of course a bullet or several shell fragments carrying with them clothing, skin, or other foreign material is also imbedded in the muscles at various levels.

The choice of treatment, therefore, depends upon the type and location of the wounds of entrance and of exit. Where a complete excision of all contaminated and bruised tissue is possible, this method followed by immediate closure is the ideal treatment. But there seems to be a general unanimity of opinion as to the danger of closing such a wound that has not been explored to the complete satisfaction of the surgeon. A deep focus of infection spreads insidiously and rapidly; during transportation close observation is usually not possible, and the patient arrives at the base with a serious intramuscular phlegmon.

The many layers of large muscles make irrigation and drainage difficult. The safest procedure in wounds left open for chemical sterilization consists in cutting transversely muscle and fascia so as to allow a gaping wound that does not tend spontaneously to close. This allows easy access to all recesses of the wound and prevents interference with drainage by the accidental overlapping of fascial or muscle layers.

The serious complications that may attend these injuries must be mentioned because of the frequency with which they occur, and because of the keen judgment and prompt execution of treatment with which they must be met.

Secondary hæmorrhage in a compound fracture of the femur is a most dangerous complication because of the frequency with which large vessels are involved, and because of the rapidity with which such a hæmorrhage may prove fatal. They invariably occur about some focus of uncontrolled infection. Control of infection and proximal ligation are necessary to prevent recurrence, which is certain otherwise to follow. Repeated hæmorrhages will very often require amputation.

Suppurative involvement of the hip or knee-joint are serious and require an early diagnosis. Possibility of invasion of the hip should always be thought of when an intracapsular fracture is found. A peri-articular infection from a shattering fracture near the condyles may ultimately invade the knee-joint in spite of every precaution. In the case of the hip, excision of the head of the femur is necessary to allow access to all of the infected joint. In the case of the knee it would be easy with the thigh maintained in extension by means of a caliper extension to carry out the method of early mobilization practiced by Willems. But a severe sepsis that does not quickly respond to drainage and chemical sterilization properly carried out, requires amputation to save the patient; when amputation is done too late, mortality is high.

SUMMARY

Immediate and continuous immobilization lessen the likelihood of sepsis.

The caliper modification of the nail extension is a particularly valuable method of reduction, because:

It is far more dependable in its extension and with less weight than a Buck's extension.

It permits complete exposure and opportunity for inspection of the thigh at all times.

It permits, as does no other method, early and continuous mobilization of the knee-joint.

It is more comfortable to the patient.

The frame above described is an indispensable adjunct in all femur fractures treated by any method of traction, because without disturbing the relative position of the fragments throughout the period of convalescence—

The patient is made independent of his bed.

Frequent X-ray control is easy.

The care of an otherwise difficult soft-tissue injury is made relatively easy.

Finally, the thigh must be inspected frequently because of the possibility of recurring infection.

DEPARTMENT OF TECHNIQUE

DEVICES USEFUL IN FRACTURE WORK

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FOR the past three years in the treatment of fractures I have made frequent use of the following described devices, the first two of which may be purchased from any hardware store.

1. Calipers to show the proper length for the bone transplant.

2. Dividers such as are used by engineers. These are most useful in finding the diameter of the marrow cavity in the fractured ends of the bone in order that the intramedullary bone dowel may be properly shaped so as to secure an exact fit. These dividers have a set screw by which it is possible to secure the points in any desired position.

3. A wooden spreader of proper length to separate the thighs and hold them firmly in a position of abduction when a plaster cast is being applied in the treatment of fracture of the neck of the femur or of fracture near the trochanter.

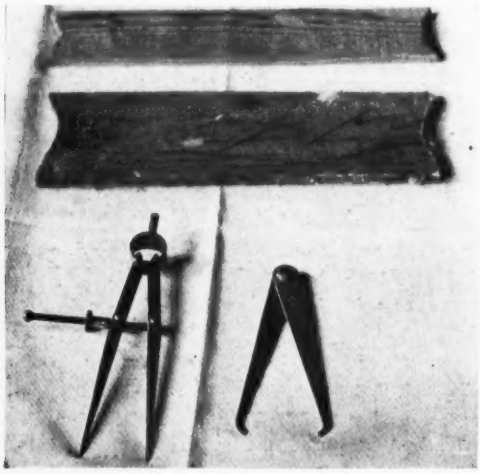

Fig. 1. Calipers, dividers and spreader.

In the treatment of such a case I usually apply a plaster cast including the foot, leg, thigh, and pelvis of the fractured side. This cast also includes the trunk as far upward as the epigastrium and the opposite thigh to the knee. Early in the process of applying this cast several extra turns of plaster bandage are applied around each of the thighs just above the knee, the inner side of each thigh having been previously well protected against possible pressure at that point. The remainder of the cast is finished in the usual manner. A light wooden spreader made of a piece of board about four inches wide and about three fourths of an inch in thickness, the ends cut concave so as to fit the curvature of the cast, is placed between the thighs a short distance above the knees, and is securely anchored in position by a few turns of plaster bandage applied alternately to the spreader and to the thighs. This spreader is obviously cheap and is easily cut to suit the amount of abduction desired.

Fig. 2. Spreader *in situ* in a case of fracture of the neck of the femur.

INTRINSIC TRIFID OR DOUBLE HOUR-GLASS STOMACH

By MAJOR JOSEPH BURKE, M. C., U. S. A.
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THE recent very interesting article by Carman, concerning hour-glass stomach has stimulated me to add a very unusual case to the literature of intrinsic hour-glass stomach, a case of true trifid or trilocular stomach due to chronic ulcers which I recently operated upon at Sisters' Hospital, Buffalo, New York.

In his article Carman refers to a case of trifid stomach observed in 1899 and reported by Mayo-Robson in 1904, but, Mayo-Robson's was a case of partial extrinsic origin. According to Mayo-Robson's own description as published in the *London Lancet*,[1] his case was not a true intrinsic trifid stomach due to ulcer. "The stomach was divided into three (3) portions, the proximal narrowing being dependent on a band of adhesions extending from the liver to the transverse colon and the distal constriction being caused by cicatrization of a chronic ulcer. The first cavity was divided into two by the firm band, leaving the middle loculus of the stomach the smallest of the three cavities and the cardiac pouch the largest." Mayo-Robson divided the firm band of adhesions forming the first constriction and "on opening the second stricture a chronic ulcer was exposed and the channel was so narrow that it would only allow the passage of a No. 12 catheter. Gastroplasty was performed, one of the largest size decalcified bone bobbins being used."

In my own case I will show a true intrinsic trilocular stomach due to cicatricial contraction of chronic gastric ulcers and as far as I can determine from a perusal of the literature it is the only genuine intrinsic double hour-glass stomach ever reported.

[1] 1904, pp. 5, and 6.

Miss M. B., single, age 27. Dr. Allen Jones who examined this patient kindly permitted me to use his case history to be incorporated in this report. I wish to extend my sincere thanks to Dr. Jones for his courtesy and interest in the case.

History. Ten years ago the patient had hæmatemesis, and since that has had periods of stomach trouble. Last January she began to have trouble and for three months she had had severe pain in her stomach at times; then she experienced a period of considerable relief.

For the past two or three months she has complained a great deal of hunger distress. Her appetite is poor. She occasionally vomits, but she has vomited no macroscopic blood. She is very tender just to the right of the umbilicus. There is also tenderness in the lower portion of the abdomen on both sides above the pubes. She is very constipated.

Examination of the stomach contents

Color	normal	Lactic acid	absent
Odor	normal	Rennin	present
Mucus	slight	Biuret	present
Total acidity	44	Propeptones	present
HCl	28–.10%	Peptones	present
Acid salts	8	Organic acids	absent
Combined chlorides	8	Tube	25"
Amount	100 cc.		

Test meal — bread and water.
Withdrawn one hour after eating.
Macroscopic appearance — well digested contents.
Occult blood — negative.

The bucket attached to the thread did not go through into the duodenum. There was no blood stain on the thread. The contents of the bucket were acid.

Wassermann-negative.

Fig. 1. Taken 20 minutes after ingestion of opaque meal.
Fig. 2. Same as Fig. 1.

Fig. 3. Roentgenogram six hours after ingestion of opaque meal.

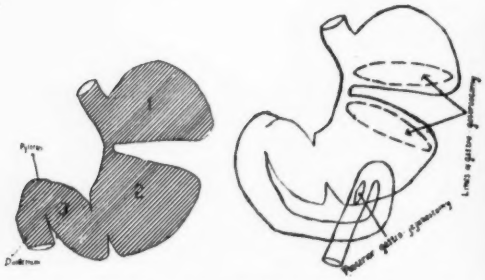

Fig. 4. (At left) Trifid or double hour-glass stomach.
Fig. 5. Operation for trifid stomach.

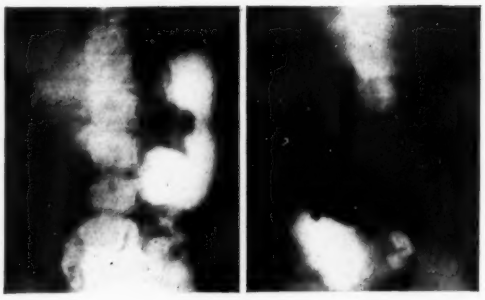

Fig. 6. Roentgenogram 23 days after operation, 15 minutes after meal. Note patulous gastro-gastrostomy and gastro-enterostomy.
Fig. 7. Six hours after opaque meal. Note barium has completely evacuated stomach and passed through colon almost to hepatic flexure.

A noteworthy feature of this case is that the report of the examination of the gastric contents gives no indication as to the real pathologic condition, except that it is the contents of a benign state, but it is a contents which is ordinarily found with a normal stomach. Without careful consideration of the history and without X-ray, accurate diagnosis would have been impossible.

Roentgen report by Dr. Lester Levyn. *Roentgenoscopic.* Opaque meal enters the stomach seven seconds after ingestion but only upper half of stomach is visualized. Peristalsis begins three minutes later and is very active. The opaque meal is forced through a very narrow canal into the lower half of the stomach, fifteen minutes being consumed before the entire stomach is filled. A typical hour-glass constriction is seen in the middle of the pars media. A second constriction is visible in the pars pylorica. The duodenal cap is slightly deformed. A small amount of the bariumized meal is ejected into the duodenum, jejunum, and ileum. Six hour observation reveals the upper or first pouch emptied but the entire lower half of the pars media and pars pylorica retain more than one-half of the opaque meal, a small amount of which has passed through the colon to a point slightly beyond the hepatic flexure.

Roentgenographic. Size, slightly dilated; form, fish-hook; position, 1½ inches above umbilical level in recumbency; tone, orthotonic; peristalsis, very active; incisura, very marked incisura in pars media, also constriction in pars pylorica; motility, retarded — over one half of contents retained at sixth hour.

Atropine administered until physiologic effects were produced revealed no difference in the incisura and constriction.

Roentgen conclusions. Double hour-glass stomach, due to callous ulcer in pars media and one in pars pylorica (Figs. 1, 2, and 3.)

I wish to extend to Dr. Lester Levyn my heartfelt thanks for the report and the illustrations.

Operation. I made an incision from the ensiform to one inch below the umbilicus about one-half inch to the right of the middle line. An incision to the left instead would have greatly facilitated the operation. Delivery of the pyloric portion of the stomach revealed a firm uniformly circular constriction about two inches in front of the pyloric ring. This narrowing was organic, not spasmodic, and due to a chronic ulcer on the posterior wall, lesser curvature. Upon further delivery and examination of the stomach there appeared a deep sulcus which extended to about one-fourth of an inch from the lesser curvature. This sulcus was due to a large chronic ulcer on the lesser curvature. These two constrictions divided the stomach into three pouches, cardiac, middle and pyloric. The cardiac was small, the middle about twice as large, and the pyloric slightly smaller than the cardiac pouch; in other words we had to deal with an intrinsic, trifid, trilocular or double hour-glass stomach (Fig. 4).

The obstruction between the cardiac and middle pouches was most marked, the lumen admitting about an ordinary sized lead pencil. The constriction between the middle and pyloric pouches was not so marked, but caused considerable obstruction, as evidenced by the X-ray examination. This narrowing was as if a cartilaginous ring was constricting the whole stomach at this point. At first I thought it might be a spasm of the stomach, but the presence of an ulcer on the posterior wall, upper curvature, convinced me of the organic nature of the constriction.

My preconceived plan of operation was that of a gastro-gastrostomy of the cardiac to the middle pouch, but the discovery of the second obstruction and third pouch made this procedure alone insufficient because it would not take care of the second obstruction. Resection of the whole middle pouch with the ulcers, would have been the ideal radical surgical intervention, but the complete delivery of the cardiac pouch necessary for the performance of such an operation was most difficult and hazardous in this case for the necessary anastomosis of the remaining cardiac and pyloric ends. To have resected the middle portion and closed both cut ends of the stomach pouches and a posterior gastro-enterostomy to the cardiac pouch, in my opinion would have been no better than the following operation which I performed.

I first made a posterior gastro-enterostomy of the large middle pouch to the jejunum as close to the duodeno-jejunal angle as would permit me to handle the middle pouch in the second stage of the operation, namely, gastro-gastrostomy of the middle to the cardiac pouch (Fig. 5).

To overcome the obstruction between the cardiac and middle pouches, I made a gastro-gastrostomy, using clamps and suture in the same manner of gastro-enterostomy, the direction of the anastomosis being vertical, the line of suture being the whole width of the stomach.

There was very little reaction after the operation, once only did the patient vomit a small quantity of blood. The convalescence was uninterrupted. On the fourth day after operation the patient was taking soft foods without distress. The patient now is able to eat everything, with no gastric complaints.

Roentgen examination (Dr. Levyn) twenty-three days after operation reveals an excellently functionating stomach. The opaque meal passes from the cardiac end through a perfectly patulous orifice at the site of the gastro-gastrostomy to the gastro-enterostomized opening and is ejected rapidly into the jejunum (Fig. 6).

None of the bariumized meal passes the pylorus.

Six hour examination shows no gastric residue and the column has advanced through the colon almost to the hepatic flexure (Fig. 7).

SOME POINTS IN SURGERY OF THE EXTERNAL CAROTID ARTERY

By WILLIAM PERRIN NICOLSON, M.D., F.A.C.S., Atlanta, Georgia

A GLANCE at the literature of surgery would reveal the fact that while ligation of the larger vessels has been somewhat fully described, there is little in reference to ligation of the external carotid, and the writer feels that a somewhat extended experience with operations upon this vessel may be presented with some interest and profit.

When we consider the anatomical arrangement of the vessels of the neck and study their distribution, we can but reach the conclusion that Nature has so distributed the circulation as to extend to us an invitation to utilize this most valuable means of producing a temporary ischæmia in operations involving this region. The subclavian supplies the lower portion of the neck. The common carotid divides into two branches, the external and the internal, the external supplying the blood to the extracranial structures, while the internal carotid without giving off a branch enters the skull supplying the intracranial structures. The only exception to this distribution is the middle meningeal, which enters the skull from the external carotid. For many years, ligation of this vessel was not considered possible, for when the ligature came away, there was not space enough between the branches for a thrombus to form, and secondary hæmorrhage was almost a certainty. Hence the surgery of this vessel became possible with the finding of a ligature that remains in place.

On May 21, 1891, in the earlier years of my surgical work, I was called upon to remove my first upper jaw, and the current descriptions of the technique of such operations gave a gloomy picture of hæmorrhage, shock, and death. It occurred to me at this time that a preliminary ligation of the external carotid might check hæmorrhage and simplify the operation. My patient was in the country and could not be removed to the city, because her baby was only 8 days old, and operation could not be delayed for the sarcomatous tumor was growing with great rapidity. The patient was removed from her bed to the operating table. After some difficulty, due to natural timidity, the vessel was tied with No. 2 catgut ligature, and the wound closed. The first incision in the face bled so freely that it appeared as if some mistake had been made, but the hæmorrhage soon ceased and the jaw was removed successfully, without tying another artery. A report of this case was published in the *Atlanta Medical and Surgical Journal*, and afterward abstracted by Dr. Matas in Davis's *Medical Annual*, and from this starting point, as far as I know, began the deliberate ligation of the external carotid for the purpose of controlling hæmorrhage. Since that time, a large experience has forced upon me the conviction that this procedure has not been appreciated by the surgical profession.

It is a notable fact that all operations upon the head and face are by force of circumstances bloody, and when the operation involves an opening into the mouth, there is the added danger of blood finding its way nto the air passages. We even find at this day recommendations for preliminary tracheotomy and pharyngeal plugging. Ligation of the external carotid absolutely controls all serious hæmorrhage, shortens the operation, prevents shock, and places the operation upon a plane within the reach of any surgeon.

The first question that naturally arises in regard to procedure is that of the danger incident to the operation. So far, in my experience, I can pronounce it *nil*. I have tied the artery more than a hundred times. Four times, both external carotids were tied at the same operation; twice a common carotid at one side, and external upon the other; eight Dawbarn resections of the entire external carotid upon both sides, with an interval of a week between; and eighty-two single ligations, for the purpose of controlling hæmorrhage. In no case has there been a death. This I believe should establish the fact that the

operation is safe. In a discussion of the Crile operation of carotid compression, I advanced the idea that ligation is safer in the average hands. Dr. Crile replied that he believed the mortality of external carotid ligation would be as much as 2 per cent from embolism. Since that time, the textbooks have it that Crile says the mortality of external carotid ligation is 2 per cent, which shows the weight of the thoughts of a great man.

It is my purpose to mention some of the conditions in which ligation has been clinically exceedingly useful to me. In the first place, in any operation about the face or neck, in which hæmorrhage may become a serious factor, it simplifies the work wonderfully. It does not prevent bleeding, but makes it controllable without ligature by simply clamping bleeding points for a few minutes. Perhaps its principal usefulness is as a preliminary step in the removal of the upper and lower jaws. It should always be done under the same anæsthesia, and not a few days before removal of the jaw, as has been recommended by some. In jaw cases, though hæmorrhage is often very free for a short time, no ligature is required, even for the temporal or internal maxillary arteries. Ligation takes from the operation of removal of the jaw all its terrors, and makes it a procedure practically free from difficulty and danger. In removal of the gasserian ganglion, it has been pronounced by many as unnecessary and not helpful, and to this I most respectfully disagree. There are two factors in this operation fraught with serious hæmorrhage: the scalp and the middle meningeal artery. Writers speak of the ease with which hæmorrhage from a torn meningeal can be controlled by ligation or pressure, but tying the external carotid has been in my hands easier than tying the meningeal. In his textbook, an eminent author advises that if the middle meningeal is accidentally injured and cannot be tied, the skull should be packed and the operation resumed two days later. In a case in which this occurred in my own work, after trying in vain to control the artery, we tied the external carotid in five minutes, the hæmorrhage ceased, and the operation was completed without further difficulty. Carotid ligation before a ganglion operation disposes effectually of the meningeal as a cause of worry and danger. In removal of fibrous tumors in the back of the throat by throat surgeons, in which hæmorrhage is such a serious factor, I have done the ligation for them, and the tumors have been removed without difficulty and with little hæmorrhage. In removal of the tongue and floor of the mouth, it is exceedingly useful, making the balance of the operation simply one of trimming away the growth. In removal of the lower lip for cancer, I have found the operation exceedingly useful, and it in no way interferes with primary union afterward. An interesting case in my experience was a young lady who had been bleeding for a week from the extraction of a lower molar tooth, until she had become exsanguinated in spite of all efforts by various means to control the hæmorrhage. The external carotid was tied in a little more than 10 minutes with immediate control of the hæmorrhage and a speedy recovery.

In regard to the technique of this operation, one has only to follow the description in the textbooks to be convinced that the descriptions are based upon the work upon the dissecting table. There seems to be a healthy respect among most surgeons for the carotid triangle, but its anatomy is well defined and very fairly constant. The anatomical relations, from a surgical standpoint, while important, are easily handled. The bifurcation of the common carotid, in the majority of cases, is opposite the upper border of the thyroid cartilage, and in a series of operations in my hands, has never been below that point. In many cases, it is much above that landmark, even extending up under the angle of the jaw. In one case in which the bifurcation was normal on the right side, it was in the edge of the parotid gland on the left. In two cases, no bifurcation was found, and in these, the common carotid was tied. The relation of the carotids to each other is pretty constant, for it should always be remembered that the external carotid is nearest to the medium line. In three cases, I have seen the vessels lying upon top of each other, and in all of the cases, the external was the most superficial. The relation of the internal jugular vein to the carotid is quite variable. In some cases it overlaps the vessel and requires retraction during the ligation, but in very many cases, this relation is not seen. Perhaps the most embarrassing finding is the combined trunk of the facial and lingual veins crossing at right angles, and in many instances forming a very large vessel. The hypoglossal nerve is not in relation at the point where I ligate. Anatomically, the external carotid is a superficial vessel, and in thin necks, it actually is so, but it is very deep in thick short necks.

I know of no description of this operation that goes much into details that can help one seeking guidance. A skin incision four inches in length is usually advised but an opening of from one to one and a half inches, with its center opposite the

upper border of the thyroid cartilage is usually ample. The incision should go through the skin and platysma muscle. After the deep fascia has been opened, I know of no operation in which the finger is more useful. With the index finger, the way can be rapidly torn down to the vessel, without damaging any of the structures. We are often told that the guide to the vessel is feeling the pulsation with the finger, but the rapid breathing of the patient makes this very unreliable. It is a useful thing to remember that the common carotid always has a bulbous swelling just as it bifurcates, and this I have found a valuable guide. The vessel is recognized by its yellowish white color. I do not find any distinct sheath at this point, though we are told to pick it up and open it. My rule is to pick my way down to the bare artery with a tissue forcep and the point of the finger. Should the trunk of the lingual and facial vein cover the artery extensively, it can be pulled out of the way with a hook or can be cut between forceps, and it should be tied at once. In a case in which the forceps were left on, in the haste due to a sudden hæmorrhage at another point, the forceps were taken off, and when the ligation had been completed and we were looking into a dry wound, there was a sudden and horrible gush of blood, which at first was inexplicable, but it turned out that the compressed end of the vein had opened up.

I take issue with what is usually described as the point of election, namely, between the facial and lingual branches. The point of election with me is the immediate crotch of the vessel, for thus no space is left in which thrombus can form. I have never seen any allusion to the relation of the anatomy or surgery of this vessel to the dense connective tissue, the remains of the carotid gland which binds the trunks together. At this point, the space between the vessels is simply an indistinct groove. The aneurism needle is passed from within outward, and when it comes against this tissue, it appears as if coming directly through the walls of the artery. I rub the point through with the finger or some instrument, and thread it, and withdraw the ligature with it. This seems to work more satisfactorily than when it is threaded beforehand.

A practical point of extreme value is to have the anæsthetist place his finger upon the temporal artery, and the operator either cross or pull upon the ligature, to see that it stops the circulation in the temporal. I know this is important, because once when I did not take this precaution, I tied the internal by mistake. Fortunately, we were able, with sharp-pointed scissors, to cut the ligature and release it without any damage to the vessel.

The ligation should not be done with a grunt and a jerk, because Ballance and Edmonds, many years ago, demonstrated that a pressure of three pounds was sufficient to close the common carotid. Just enough force should be used to stop the circulation, and bring the inner walls of the vessel together. I always employ a double strand Ballance knot with No. oo or No. o forty-day chromic catgut. Larger sizes of catgut are entirely unnecessary, and I believe sometimes harmful. All clamped vessels are now tied with fine catgut, and the skin closed with No. oo chromic catgut without drainage. In many cases, the entire operation can be completed in a few minutes, and the ultimate shortening of the entire operation is so great that these few minutes are well spent. Dawbarn, in his prize essay, demonstrated that there were 17 different routes by which the anastomotic circulation takes place, so that in a few days, pulsation returns in the trunk of the temporal artery.

The statement I have made that in the average hands ligation is a simpler procedure than Crile's compression of the common carotid, is based upon the fact that ligation controls the same area of arterial distribution, and I believe carries less risk than cutting off the circulation from the brain, even though this does not last longer than a few hours. An ischæmia of the brain for this length of time may be accompanied, I should believe, by some danger of change in the brain cells. In conclusion, I wish again to state that I believe that this operation of closing the external carotid carries with it valuable features that have been overlooked and must some day be fully recognized. To those who desire to simplify surgery of the face and head, it is a consummation devoutly to be wished.

A NEW STRAIGHT PROSTATIC TRACTOR[1]

By W. O. WILDER, M.D., Baltimore
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IN reviewing the literature on perineal prostatectomy, especially as pertains to the operative technique, it will be noted that one of the main features of the various variations of this operation has always been the securing of as prominent a position of the prostate as possible in the field of operation by means of some form of tractor introduced into the bladder through an incision in the membranous urethra.

Syms suggested the rubber bag, Lydston the coat hanger style tractor, and de Pezzer and Young have presented very ingenious styles of tractors whose blades open after introduction into the bladder.

The Young tractor has proved especially popular and efficient on account of its comparative ease of introduction, simple construction, strength and durability.

Still in this clinic for some time past, in the routine operation for carcinoma of the prostate with a small rigid vesical orifice, a distinct need has been felt for a tractor which might afford a more easy introduction than any of those previously mentioned.

Some years ago Moore, of Indianapolis, offered to the profession a form of straight tractor whose blades were opened after introduction into the bladder by means of a thumb screw on the handle. Although the idea was an excellent one, its usefulness was rather limited on account of its necessarily large caliber and its weak construction.

Being thoroughly convinced that a straight tractor, if one could be constructed of sufficient strength and of a moderate caliber, would possess the features demanded in such cases of small rigid vesical orifice, the author has designed the tractor herein described. Its practicability and usefulness have already been demonstrated to be of such a degree as to cause its general adoption in all perineal prostatectomies performed in this clinic during the last year and a half, although its value is especially notable in the cases of carcinoma of the prostate where a small rigid orifice is always to be found.

In the accompanying photograph two positions of the blades are shown; one with the blade in direct line with the long axis of the shaft, the closed position of the tractor blades as when introduced through the slit in the membranous urethra into the bladder, and the second position, the final position of the blades, at right angles to the shaft. The spreading of the blades is attained after their introduction by rotating the thumb screw on the handle. The shape of the blade tips and the caliber of the shaft F28 render a most easy introduction with small danger of stripping back the mucous membrane of the urethra.

[1] From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital.

SCALPEL SHARPENING

By G. G. LITTLE, M.E., Rochester, Minnesota
Surgical Instrument Shop, Mayo Clinic

IT takes time and patience to acquire the ability to sharpen scalpels properly, and to give to every knife edge the same keen smooth sharpness. There is quite a trick in getting the right swing to the knife as it is being passed over the sharpening stone. Keenness is acquired by reducing the edge to a thinness limited only by the strength of metal required to keep it from breaking out or nicking too easily. Smoothness is to be had only by the use of the finest abrasive stone known, and several important factors should be taken into consideration in selecting the stone for scalpel sharpening.

There are two kinds of abrasive stones that are the most adaptable to scalpel sharpening. They are composed of an even grain or hard crystalline structure that gives the desired cutting edge to the knife blade and retains a smooth true surface much longer than any other stones. Such properties are all very important when the stones are in constant daily use.

The first stone is known as the Pike India oil stone and is used for quickly reducing the cutting edge to the required thinness preparatory to giving it the smooth cutting angle.

The second is known as the hard Arkansas oil stone which is a natural stone quarried near Hot Springs in the Ozark Mountains of Arkansas and is composed of millions of pure silica crystals, microscopic in size, of the greatest hardness and sharpness. So perfectly crystallized is this stone that it is nearly sixteen times harder to cut than marble, a feature of great importance, as it enables the hardest steel tools with fine points or blades to be sharpened without grooving the stone.

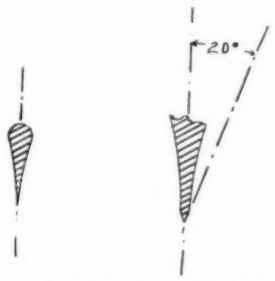


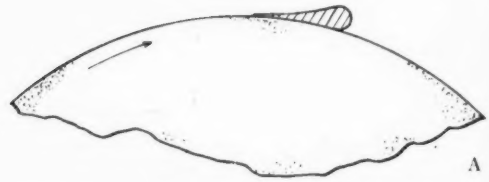
Fig. 1. Cross section of a scalpel blade the sides of which are slightly concave. The surfaces come so close together that near the edge they are parallel and terminate in a cutting edge as shown at the right, enlarged.

The Pike India oil stone is made of alundum which is a remarkable reproduction of the natural mineral corundum. Alundum is made by fusing bauxite, a soft earth resembling yellow clay and chemically the purest form of aluminum oxide, in the intense heat of the electric furnace. The advantage of alundum over every other known abrasive lies in its peculiar combination of hardness, sharpness, and temper. By temper is meant strength of grain and ability to wear under pressure. These stones, the Pike India oil stone and the hard Arkansas oil stone, are absolutely uniform in hardness and texture, most important qualities.

There is a softer grade of the Arkansas stone that is more suitable for sharpening large knives that do not require the keen sharpness of the scalpel.

A light oil should be used to float the fine particles of steel away from the surface of the stone thus keeping it cutting freely. We use gasoline

Fig. 2. *A*. The position of the blade relative to the stationary stone when being reduced to the proper thinness. *B*. Passing the blade over the surface of the stationary stone to reduce the edge, the proper movement is to hold the blade down flat with just enough pressure to cause the stone to cut, move it lengthwise of the stone and near the end of the stroke raise the handle gradually, thus causing the curved side to come into contact with the stone and reduce the edge clear to the point. The movement is repeated in the opposite direction for the other side of the blade.



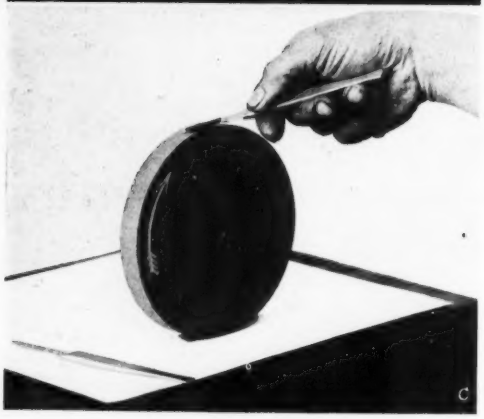
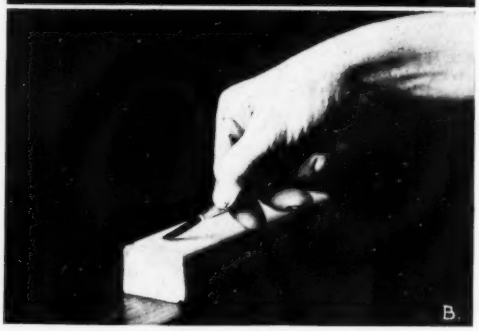


Fig. 3. *A*. The position of the blade relative to the circular stone, the radius of which (3″) controls the amount of concavity given to the blade while being reduced to the required thinness. *B* and *C*. The circular oil stone for reduction. The blade is placed on the face of the wheel and as the stone cuts away the metal the blade is drawn back and the handle gradually raised bringing the curved side onto the wheel and reducing the edge clear to the point.

because of cleanliness; oil, no matter how light, will leave on the hands and on the work, a film that is more or less disagreeable.



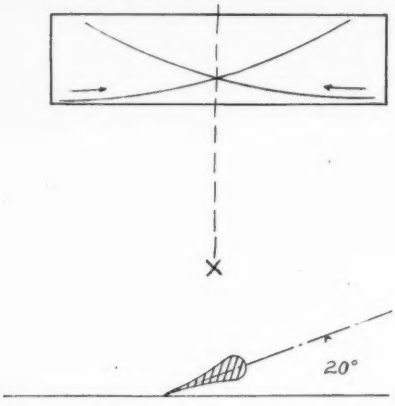


Fig. 4. *A* and *B*. The position of the blade ready to pass over the hard Arkansas stone and to receive the final cutting edge; *A* being the starting point and *B* the end of the stroke. The handle has been raised to bring the whole cutting edge in contact with the stone as the blade passes over it. *C*. The top of the stone with two curved lines drawn on the surface which represent the path of the blade as it passed along. The movement is made as though to scrape the lines off and the entire edge is used. At the start of the movement the blade is held with the heel touching the rounded corner of the stone at the right-*A* and with the back of the blade raised about 20 degrees off the stone to give the proper angle to the cutting edge *D*.

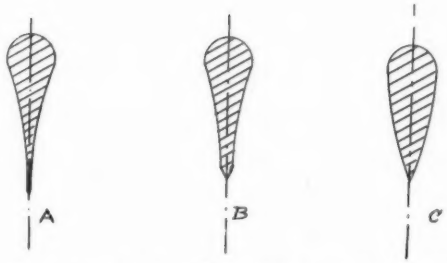
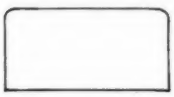


Fig. 5. *A*, *B*, and *C*. Three blade sections. *A* is the outline of a perfectly shaped blade section that can be given a very keen sharp edge, while *B* is an outline of a blade section that has been sharpened without reducing the thickness so that it has become too thick to be made keen, though the cutting angle may be the same. *C* is an outline of a blade section that has been reduced on a flat stationary stone and shows that care was not taken to keep the sides straight, instead they were allowed to become rounded off toward the cutting edge making it hard even to sharpen it.



B

Fig. 6. *A*. Stone being rounded at the corners by rubbing it on a sheet of abrasive cloth on a flat surface. *B*. Shows the corners rounded to give a continuous surface for starting the stroke of the blade and to remove a possibility of nicks on which to catch the edge of the blade.

When there is a large number of knives to be kept sharp it is advisable to install a motor driven circular oil stone (Pike India stone of medium grade) for reducing the blades to the required thinness, as the work can be accomplished in less time than if the flat stationary stones is used.

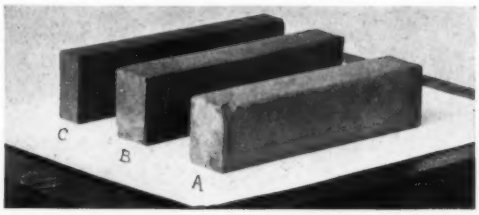


Fig. 7. Three oil stones. *A* the hard Arkansas, *B* the soft Arkansas, and *C* the Pike India. The first two stones are 1½ by 2 by 8 inches and the Pike India is 1 by 2 by 8 inch they are all standard size and can usually be bought of or through any hardware dealer who handles fine tools, or direct from the Pike Mfg. Co. of Pike, New Hampshire.

Fig. 8. Calf skin leather (soft finish) is folded once for testing keenness. The edge of the knife is carefully touched to the rounded surface with a slight draw movement which will cause it to cut the leather.

The first step in the process of scalpel sharpening is the examination of the cutting edge to determine its thickness, and to learn whether the edge is of the required thinness or whether it must be reduced before it is resharpened. Along the cutting edge will be seen a bright polished line on both sides of the blade. These lines are called "lands" and are caused by the action of the hard Arkansas stone as the blade is being given the final cutting edge. After the blade has been properly reduced to the required thinness it may be resharpened about four times before it is reduced again, though it is advisable to give it a few strokes on the Pike India oil stone (the stationary one) and then give it the final cutting edge on the hard Arkansas stone. Note that the edge of the blade is always forward when sharpening so that the wire edge is worked off instead of being put on.

The proper position of the operator while sharpening a scalpel is to the left of the stone so that the elbow is at a level with the surface and on a line with the center (Fig. 4, C).

PROSTATECTOMY COMBINING THE ADVANTAGES OF THE SUPRAPUBIC AND PERINEAL METHODS USUALLY EMPLOYED[1]

By A. J. OCHSNER, M.D., LL.D., F.A.C.S., Chicago
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THE following method of performing prostatectomy has proved so satisfactory in my hands that it seems worth while to suggest that others give the operation a trial. Before adopting this method, I made use of the suprapubic method which was popularized by Freyer, of London, and the perineal method employed with such marked success by Young, of Baltimore.

Both methods are satisfactory. The former is simpler and can be executed in less time, exposing the patient to a shorter period of anæsthesia. This, however, is of much less importance since we employ spinal anæsthesia in all cases in which the patient is very old or in which there exist other reasons contra-indicating the use of ether anæsthesia. In a large proportion of these cases, however, the drainage of the bladder is not satisfactory and the period of healing of the suprapubic wound is long and exceedingly disagreeable to the patient.

The perineal operation, on the other hand, is much more difficult except in the hands of experts with a large experience, and even in such hands the average time consumed is about four times as great in this operation as it is when the Freyer method is used.

The drainage is satisfactory and in expert hands the results are about equal.

In these patients who are generally old and not good surgical risks, it seems important, if possible, to combine the good qualities of these two operations in a method which will embody the advantages of both methods and avoid their disadvantages.

The reason that it is possible to execute the Freyer method with such ease and facility lies in the fact that, after the bladder has been opened through a suprapubic incision, the finger can be carried into the urethra and the mucous membrane cut or torn. The end of the finger then rests between the gland and its capsule and the finger can be swept around the gland so that in a few moments it is entirely free. This is true except that in some instances there are a few adhesions to the urethra, but these can be quickly severed with scissors.

Any hæmorrhage can be controlled readily by means of a gauze tampon placed firmly within the capsule. The entire operation is extremely simple and safe and quickly accomplished. Were it not for the troublesome drainage the suprapubic operation would be ideal.

The advantages of the perineal route mentioned above lie in the fact that the hæmorrhage can be easily controlled, the gland can be exposed to view, and there is ideal downward drainage. However, the method is too complicated and tedious to perform in patients in whom the margin of safety is very small at best and it should not be done except by the surgeon who has become expert through much experience.

The following method which I have employed in a large number of cases contains all of the advantages and none of the disadvantages of the two methods just described.

The patient is given a hypodermic of one-quarter grain of morphine and one-hundredth grain of atropine, half an hour before the ether is administered by the drop method. Everything is in readiness so that no time whatsoever is lost from the beginning of the anæsthesia to the end of the operation.

The bladder is irrigated with permanganate of potash solution, and a sufficient amount is left in the bladder to cause it to be moderately distended but not sufficiently to cause a possible rupture. The patient is then placed in the lithotomy position and a grooved sound is introduced into the urethra down to the perineum.

An incision is then made corresponding to the lateral incision formerly practiced in the operation of perineal lithotomy, extending from a point half-way between the scrotum and anus, to a point half-way between the left tuber ischii and the anus, and extending down into the membranous urethra which is opened at this point sufficiently to admit the point of an old fashioned lithotomy knife. The sound together with the lithotomy knife are passed into the bladder, care being taken to carry the sound along the pubic bone in order to prevent the knife from cutting into the rectum, thus splitting the membranous and prostatic urethra posteriorly. The knife is

[1]Read before the Chicago Surgical Society, February 6, 1919. (For discussion, see p. 97.)

then withdrawn, and the operator's finger is carried through the incision along the sound into the bladder.

The finger is now precisely in the same position that it would be if a suprapubic opening had been made, and in this fact lies the important advantage of this over other methods of operation, because beginning from above and entering the capsule of the prostate gland through the urethra, one is in a position to enucleate the prostate precisely as though the bladder were entered from above through the usual suprapubic incision and the prostate gland were to be enucleated according to the Freyer method.

This step of the operation should be carried out with the utmost care in order not to disturb the bladder or urethra unduly. If bands of adhesions are encountered a pair of blunt curved scissors should be carried along the finger and these bands can be cut. Presently the entire gland is free from its attachments to the urethra and the capsule, and the gland is withdrawn through the perineal incision by means of Young's forceps. The area is then carefully explored with the finger and occasionally an additional lobule of prostatic tissue is found which has to be enucleated.

The index finger of the left hand is then introduced into the neck of the bladder, and the capsule of the prostate is caught by means of fine toothed forceps, one being applied to the right and one to the left, and a drainage tube consisting of an inner tube 1 centimeter in diameter and covered in its middle portion by a second rubber drainage tube just large enough to slip over the first one, is introduced into the bladder, the inner tube extending into the bladder, and the outer tube into the capsule.

Ferguson's retractors are then applied to each side. The capsule is held in position by means of the fine toothed forceps, and gauze is packed around the rubber tube into the capsule. The double tube prevents collapse, and offers a sufficient amount of resistance to make the tamponing effective for controlling the hæmorrhage.

The rubber tube is held in place by means of silkworm-gut sutures which pass through the edge of the wound and the outer rubber tube.

Two days after the operation, the tube and packing are removed. Occasionally, one encounters a prostate gland which is hard and fibrous and cannot be enucleated. In this case it is removed by gnawing away piecemeal under guidance of the finger by means of the Ferguson gnawing forcep.

The entire operation can usually be performed in less than fifteen minutes. The shock is minimal, the amount of traumatism is not extensive, drainage is downward through the perineum in the most comfortable and most effective position, and hæmorrhage is controlled by the tampon. The drainage tube and tampon are removed after two days when the patient can sit up. After the fifth day, the patient can take daily tub baths and within two weeks the urine usually begins to pass normally.

Older surgeons, who have had experience in perineal lithotomy before the time when suprapubic lithotomy usurped this field of surgery, very properly, will remember with what ease and facility stones were removed through a perineal incision representing the first step of the operation just described and how perfectly free from pain and discomfort these patients were after this operation, and how quickly and perfectly the healing took place, free from complications and with end-results which were most satisfactory.

Any surgeon who has previously performed suprapubic prostatectomy will appreciate the fact that the moment he carries his finger up into the bladder through the perineum the removal is quite as simple and easy through this route if the same method of enucleation is carried out and the procedure is really more convenient. This is true especially in fat patients with thick abdominal walls. One must, however, always carry the finger first up into the bladder and proceed with the enucleation from above downward.

We have here then a method which embraces all of the desirable and none of the undesirable points of the two methods first described.

In case general anæsthesia is employed, it can be discontinued after the first incision has been made because the operation will be completed before the patient realizes any pain. A very small amount of ether is required for the operation.

In all patients who are not perfectly good risks for ether anæsthesia, we invariably make use of spinal anæsthesia which is borne exceedingly well by these cases. We use one grain of apothesine or novocaine with adrenalin.

It is well to dilate the sphincter ani muscle before beginning the operation in order to increase the comfort of the patient during the few days directly following the operation.

The after-treatment consists in the administration of an abundance of distilled water and the giving of light diet.

The tube and the tampon are removed after two days, and the patient is permitted to get

out of bed. After the fifth day, he is given daily hot tub baths also an ounce of mineral oil at bedtime.

In case there is a tendency for phosphates to accumulate in the wound, the patient is given two or three drops of dilute hydrochloric acid in half a pint of distilled water every hour until the phosphates disappear.

The postoperative course of these cases and the results are as uneventful and satisfactory as they were in the perineal lithotomies.

It is wise in every case to search the bladder carefully for the possible presence of calculi which may otherwise be readily overlooked.

Thousands of old men die annually as a result of complications caused by obstruction due to hypertrophy of the prostate gland and their lives could be prolonged many years. Others continue to live in great discomfort who could enjoy a comfortable old age if this form of treatment which can be carried out by any good general surgeon were systematically employed.

The complications of prostatic obstruction causing the greatest number of fatalities are pyelitis, uræmia, and chronic and acute nephritis, and many of the cases suffering from these maladies die annually of pneumonia because with their lowered vitality they are more subject to this infection and less able to withstand it.

Of course, all preliminary preparation which is indicated for the purpose of getting the patient into condition for any type of prostatectomy must be employed with equal care in these cases.

The use of urotropin dissolved in distilled water for a period before the operation, and daily irrigation of the bladder with boric acid or permanganate solution should be practiced in all cases in which the urine contains much pus and in which there is a considerable amount of residual urine.

In cases in which the passage of a catheter for the purpose of irrigation causes much pain or gives rise to chills or fever temporary suprapubic drainage should be employed for a week or two before making a prostatectomy.

The tube can be accurately fitted and sutured in place so that the urine will be siphoned into a bottle leaving the patient dry and comfortable. This tube is left in place for one to two weeks before and after the prostatectomy. This preliminary operation should be done under local or spinal anæsthesia.

OPERATING-ROOM TECHNIQUE AND AFTER-CARE OF PATIENTS[1]

By COLEMAN G. BUFORD, M.D., F.A.C.S., Chicago

I AM quite aware of the possibility of exposing myself to criticism for consuming your time with the much worn topic of operating-room technique and postoperative care of patients. I believe you will be tolerant when I remind you that since the advent of antiseptic surgery the practice of each five-year period has been more or less unlike the preceding one, that our present views are very different from those we originally held and at all times there has been considerable difference among us as to the methods practiced, and I believe that you will agree with me that an occasional discussion of this subject is not unfitting. It must be borne in mind that overenthusiastic writers and the well established custom of surgical visitation, bringing home new ideas, are responsible for the introduction of some good and some wholly useless methods into general use. For some years past I have been departing from the usual routine, and I have been gratified to find that others are doing likewise, and that our experiences have been equally satisfactory; in other words, there seems to have been an unspoken evolution going on and each man has hesitated to recite his experiences.

In my own work, I have made it a rule at the beginning of each winter to make a survey of my operative technique at the Children's Memorial Hospital, revising it where necessary and calling the attention of my co-workers in the department to such revisions and the reasons for them.

About two decades ago it was still customary in some clinics to have patients enter the hospital one to three days in advance of abdominal operations for the purpose of rest, the thorough emptying of the gastro-intestinal tract and the preparation of the field of operation by a generous scrubbing with soap, water and brush followed by the constant application of a wet dressing of some antiseptic. More recently Crile has given us the idea of anoci-association, including in his papers convincing slides showing the cellular changes in the central nervous system of animals exposed to fatigue before death. It is just to

[1] Read before the Chicago Surgical Society, February 6, 1919. (For discussion see p. 98.)

assume that similar changes would occur in case of fright. Using these as a basis for the practice, many clinicians have adopted the custom, especially with patients suffering from exophthalmic goiter, of having them enter the hospital some time in advance of the operation to accustom them to their environment and free them from operative and anæsthesia fear. Daily inhalations of an anæsthetic were given with the pretense to the patient that it was a part of the treatment. On a day not made known to the patient, complete anæsthesia was induced and the radical operation performed. Previous to Crile's publications, I had adopted the opposite practice with exactly the same object in view. My interval work is done on set days beginning at two o'clock in the afternoon. I ask the patients to enter the hospital before ten o'clock in the morning of the day of the operation. This, of course, does not apply to patients who are very seriously ill, or upon whom a diagnosis is to be worked out after they reach the hospital, or upon whom the gastro-intestinal tract is to be opened, or to those for whom it is more convenient to enter the hospital earlier. It especially applies to those having chronic lesions of the breast, neck and axilla, chronic gall-tract lesions, chronic appendicitis, hernia, chronic affections of the pelvic genitalia and practically all goiters. The relative value of this plan can best be estimated by reference to my goiter work alone. It is about eleven years since I did my first goiter work. There have been no deaths and no serious complications among the reasonable risks. Five of these showed very seious cardiovascular and mental damage, and of this group two could hardly be classed as conscious of what we were about to do for them; therefore, the element of fright was almost eliminated. These represent the only two deaths I have had. My experience has been sufficiently voluminous and so satisfactory as to cause me to feel that to obtain the best results it is not needful to hospitalize patients before operations in conformity with the theory of anoci-association. I do not attempt to mislead patients concerning the seriousness of operations, at the same time I attempt to give them whatever just assurance and confidence I can, and urge them to enjoy themselves as freely as possible in the interval, but without dissipation. I believe that the night previous to the operation spent away from the hospital is apt to be more restful. Full meals including breakfast on the morning of the operation are encouraged, except where the stomach or intestines are to be opened. No catharsis whatever is indulged in. The patient is requested to go to bed at once upon reaching the hospital, and if possible to go to sleep. An enema is given an hour or more before going to the operating room. One-eighth to one-quarter of a grain of morphine and one-one hundred and fiftieth of atropin are given hypodermically three-quarters of an hour before the operation.

The field of operation is prepared before the patient comes to the operating room, either in his room or in the preparation room, the object being to allow the anæsthetic to be proceeded with as soon as the patient is properly placed upon the table and thus diminish operating-room fright. We also thus avoid a considerable source of danger through the scattering of soap bubbles and drops of water in the operating room, avoid confusion and shorten the period of anæsthesia. If one times the preparation by the watch after the patient is asleep he will usually find that the patient has been unnecessarily narcotized for more than a quarter of an hour. I think that careful observation will show that there are a good many flaws in the technique of the preparation of the field of operation when it is done by transitory help, unless it is supervised throughout by a stationary, experienced and reliable person. In most cases the fields prepared are too small and the coverings become dislodged because of the insecurity of bandages and much time is lost in re-preparing on this account. In radical operations on the neck we commonly find the occipital region unshaved and the upper part of the chest unscrubbed and unprotected; in appendices, hernias and suprapubic incisions only the suprapubic hair has been removed and there has been inadequate preparation of the external genitalia and the upper part of the thighs. I believe that the matter is important enough to justify all of the preparation work in large hospitals coming under the direct supervision of one stationary and experienced person.

When Lawson Tait told us that the careful removal of fat and epithelium by the liberal use of soap and water was an adequate surgical preparation, those of the opposite school, who were using soap poultices, soap, water, bichloride and alcohol preparations, followed by wet dressings of bichloride of mercury, looked upon him as a heretic. I think we are coming nearer his view than that of the opposite school. I would be quite content with a liberal gauze sponging of the field with benzine, followed by alcohol, and drying, but have had to abandon this method on account of the frequency with which transitory help allowed benzine to gravitate to other parts of the body where it was not noticed and resulted

in severe blisterings.[1] I have used soap, water and alcohol preparation long enough to believe firmly in its adequacy, but allow the use of any other antiseptic solution which conforms with the hospital routine because I consider it unimportant.[2]

I believe that all blankets should be left outside of the operating room as they are rarely carefully handled and are certainly sources of danger because of the dust and lint shaken off them. I believe that special coverings should be provided in the operating room, enveloped in muslin slips, and that in abdominal operations they should be in sections so that a warm, light, narrow cover could be placed over the chest and another below the field of operation, thus avoiding unnecessary weight, heat and the piling up of a thick, dirty article close to the field of operation.

When the patient is sufficiently narcotized and the dressing removed, the field is quickly sponged with alcohol on gauze and dried. While there may be some use for iodine in accident and military surgery, I believe that it is harmful, misleading and unnecessary in ordinary surgical practice. If one paints his own skin with a thick coating of iodine and then covers it with a thick dressing he will soon obtain some idea as to what it may do to buried tissues. It is an irritant to say the least. In abdominal work I consider it especially harmful because if it is allowed to get upon the peritoneum it must cause serious chemical irritation and damage and exfoliation of endothelium which we are striving to keep intact. Results without it in my hands are sufficiently satisfactory to cause me still to refrain from using it.

After drying, the field is surrounded by linen. It is right here that I feel that considerable leakage occurs in our asepsis. I notice the return of the use of sheets below and above the field of operation which are tucked around the field and in the direction of the anæsthetist. It is during this tucking that the hands frequently become contaminated, of course, without being noticed by the one at fault. These sheets are often piled high and lie wrinkled and insecure when first applied. After a little shifting one is not quite sure just what area has touched the skin or clothing of the patient. It seems much more simple for us to go back to the draping of the field with towels which are covered only by one laparotomy sheet with an opening in it which may be enlarged by unbuttoning, or made smaller by the use of added towels. The skin clips, an invention of recent years, should always be used to prevent slipping of the linen, especially on the small bodies of children. Towels fixed to the edge of the incision by skin clips and turned back to that side covering the clips are very good additions to anyone's technique, and eliminate contact of the hands or instruments with the skin of the field of operation.

The sterilizing of instruments by boiling is uniform among us, and need not be commented upon except to say that needles, knives and scissors should always be boiled. It has been demonstrated conclusively that the subjection of these to 95 per cent carbolic acid does not insure sterilization. Needles need not be lost in the sterilizer if fixed in gauze or put in a perforated needle box, and there can certainly no longer be any excuse for not boiling knives since partitioned boxes which protect them from being nicked are now available. I consider it better to ruin a knife with each operation than to risk chemical sterilization. We are also told that knives are not boiled because their temper is changed. Is it not a fact that the temper of steel is not changed unless exposed to a red heat?

Long ago I adopted dry technique. At the Children's Memorial Hospital no water is allowed on the nurses' table. Blood is removed from the instruments with dry sponges.

In the use of laparotomy sponges we are confronted by two schools: One teaches that dry sponges remove more peritoneal endothelium and cause more trauma. The other tells us that wet sponges pass through one more basin and one more pair of hands, that the water may have been contaminated and the sweating hands may be covered by punctured gloves, through which infected perspiration may reach the sponge when it is wrung dry. I have for many years used dry sponges believing that the less they are exposed to handling the safer they are. It is far better to avoid the use of laparotomy sponges when possible. I think I am able to do this in more than half of my abdominal work.

In cases of diffused septic peritonitis, I consider it rarely advisable to flush the abdomen, believing that drainage facilitated by the inclined position of the body is sufficient. It has always seemed to me that by irrigation we remove the viscid covering of the endothelium which is there for protective purposes and many times it seemed to me that the endothelial covering immediately became clouded. It is argued that this is justi-

[1]When benzine is used tor cleansing the skin an oily residue remains. If covered by adhesive or left between folds of the skin blistering frequently occurs. This residue may be removed by alcohol.

[2]At the end of the meeting of the Chicago Surgical Society. where this paper was read, a member noted for his good results and great technical ability, told me he had used only soap and water and water rinsing hand preparation for five years. He uses rubber gloves.

fied in the severe cases, a view which I do not agree with because it prolongs the anæsthesia, greatly increases the trauma and shock as the hand passes among the intestinal loops, and does not conform with the idea of "get in and get out" which seems to have given us altogether the best recovery rates. I believe that the leaving of salt solution, ether, and other chemicals in the abdomen is harmful and unnecessary.

My tendency is to drain abdomens less liberally and less often than in the past, but I notice a tendency of some to return to the practice Robert Morris taught about 14 years ago of closing the abdomen after the removal of appendices in a state of advanced pathology. I think I recall a correction of this view published by him. I also recall that my unexpected appendiceal losses have been mostly in those I failed to drain. They were not all dead or ruptured appendices, but some showed advanced damage and definite exudate about the appendix which all surgeons had previously drained. In cases of oozing of consequence following extensive abrasions in the abdomen, I now always drain. When I failed to do so I found retentions occurring too often.

I close abdomens by layer sutures using No. 1 chromic gut, but to save time loop the thread to fix it as each layer is closed, and proceed without cutting the thread to the next layer. I use a running suture of iodine gut to close the subcutaneous fat where its thickness justifies closure. Fine iodine gut is used because it approximates the surfaces sufficiently to prevent the leakage of fat from the cut surfaces, effaces dead spaces into which the fat and serum may leak, and it does not linger so long in the tissues causing prolonged and marked reaction during absorption, and consequent later centralization of infection. There is also some foundation for the belief that the approximation of the subcutaneous fat by suture tends to diminish keloids. Wherever special neatness is desired I close the skin with subcuticular sutures of silkworm-gut.

More than 15 years ago I abandoned thick dressings for clean wounds, instead covering them with about four layers of gauze the length of the wound, and 1½ inches wide, over which the ends of the silkworm-gut suture are tied. I place a long, wide strip of adhesive across this in abdominal wounds, going obliquely about four-fifths around the body, following the body contour. In hernias and appendices the strip begins behind the trochanter and ends behind the lower ribs of the opposite side. In more serious and lengthy abdominal operations where I expect severe vomiting a wide strip of adhesive is run in the opposite direction, the two crossing as an x at or below the middle of the abdomen. This gives considerable support to the abdomen and if vomiting occurs makes it less distressing. Face wounds and all harelips are left without dressings. In some quarters very good surgeons are not dressing clean abdominal wounds at all.

Just a word about hand sterilization. I scrub under running water. After the soap is removed I use a 1 per cent solution of lysol followed by alcohol, both being poured from a bottle by a nurse. I direct that these be poured slowly in the smallest possible stream over the center of a basin. I believe that this is the neatest and most economic way to use hand solutions. No liberal dashes are allowed. I use lysol or any antiseptic other than alcohol to conform with the present-day teachings to internes and nurses. I have used soap, water and alcohol alone often enough and long enough in hand preparations to cause me to believe that it is sufficient. For many years wash basins have been eliminated from the operating room during my work at the Children's Hospital. They serve as catch basins for dust, lint and bubbles from the respiratory tract. It is an unclean habit and unsafe for more than one pair of hands to wash in the same water. Rubber gloves are routinely used both in pus and clean cases, but I find that it is constantly necessary to remind assistants and nurses to put them on without allowing skin contact with the outer side of the gloves. I have abandoned the use of rubber arm coverings but still use long sleeved gowns, smoothly tucked within the cuff of the glove. If arm coverings are not used bare arms are sure to come in contact with clean linen, instruments, and tissues, and in long operations there is danger of drops of sweat leaking out of the glove.

Immediately after the publication of Mikulicz's paper on the use of white cotton gloves in surgery, I purchased for the Fenger Clinic, white cotton, silk and rubber golves of different types, studied their relative value, methods of sterilization and care and their bacteriology and reported on these at the Chicago Medical Society about twenty-one years ago. I well remember how surgeons expressed doubt as to the possibility of their usefulness. If I were in charge of a large teaching clinic I believe I would return to the use of white cotton gloves in all clean work on account of economy, the encouragement of dry operating and neatness, particularly on the part of assistants. In the Fenger Clinic Dr. Waters and myself were able to show only slight staining on our gloves after assisting in many major operations.

We commonly see at the end of many major operations hypodermoclysis begun. This has undoubtedly caused endless unnecessary pain and relatively rare benefit. I believe that there is seldom any use for it. The fluid which it is intended to supply may best be given by mouth or rectum. I resort to proctoclysis very much less frequently than in former years, using it with a view of diminishing thirst in selected cases only, and in the hope of having larger quantities retained in very septic cases. I believe this to be a therapeutic measure which has been much abused in surgery. It has caused endless discomfort through unnecessary application, much unnecessary labor for nurses, and I believe the amount which is usually taken up is overestimated.

The transfusion of salt solution has also been abused, and I am told by one of the most experienced surgeons in the past war that it is looked upon by many at the front as harmful. Several years ago in a paper on "Surgery of Infancy and Childhood," I called attention to its harmful effect on children when used in cases of congenital or acquired hæmophilia where it produces hydræmia and further diminished coagulability. It is being rapidly supplanted by direct and indirect transfusion of blood which is subject to still further simplification. Among the more simple devices are those of Bernstein, of Johns Hopkins, and Abelman, of this city. My attention has recently been called to the intravenous use of solutions of gum arabic in war work for the purpose of increasing viscosity, coagulability and filling vessels.

Long before the publication of Fowler's paper I had used and I think others in Chicago were using the postoperative sitting position in certain septic abdominal conditions. I found that unless I strictly supervised it myself and used twisted sheets between the thighs, tied to each post at the head of the bed, the patient routinely slipped down, the abdomen remaining flat upon the bed and the thorax slightly elevated in a cramped and uncomfortable position. I then began and still use in cases of septic peritonitis a high elevation of the head of the bed, occasionally adding a back rest increasing the elevation only fifteen to twenty-five degrees. This secures the most certain and permanent position to promote drainage by gravity, and I think is less likely to invite thrombosis in the lower extremities because we avoid acute flexion of the thighs.

When the patients are fully awake I order as a routine an ounce of water per hour for three hours, after which two ounces per hour for three hours, then 3 ounces per hour if wanted is given until I next see the patient. Of course, the patient is not awakened for this. If vomiting persists I am inclined to encourage it by increasing the amount of water at any time, to promote emptying of the stomach.

I am certain that the time consumed in operations by all of us is shorter than in former times, that the patients are far less ether soaked and less traumatized and, therefore, there is less vomiting. In my last five appendectomies there was moderate vomiting in only one as I recall it. This patient was the only one who neared the average discomfort from gas pains. None of them had distended abdomens. I have looked upon the usual postoperative vomitings as being largely due to acute gastritis, remembering that the gastric juice is laden with ether which is in a large part eliminated by the gastric mucosa, and usually treat it as such, often resorting to the use of gastric lavage. I have also assumed that not only were the secretions of the gastro-intestinal tract perverted on account of the irritating effect of ether, but also on account of the shock due to handling the viscera. When one understands the acute digestive disturbances that immediately follow upon taking food after shock and fright, it seems quite reasonable that after operation before the gastro-intestinal tract is emptied of perverted secretions laden with ether, food will not be well taken care of. It is for this reason that all of us have refrained from early feeding. While awaiting the first feeding I see that the patient has an abundance of water to dilute and facilitate the removal of the gastro-intestinal contents. If there is gaseous disturbance or even moderate discomfort in the abdomen, enemas of plain water are given in immediate succession until there is a good result. I rarely give cathartics during the first five days following abdominal section as I believe they are commonly the starting points of our serious gaseous disturbances. There is seldom any need for the relief of abdominal pains following laparotomies by use of morphine. In cases of severe pain its use is exceptional. Evacuation of the lower intestinal contents by diligent use of enemata will often be all that is required.

All of us are acquainted with the evidences of temporary interference with nutrition in children following acute infectious diseases and even temporary digestive disturbances, as shown very clearly by the transverse linear depressions in the teeth which appear later, and also with the effect that it has upon adults who undergo considerable physical exercise before breakfast. We know that an actual

weakened condition exists following operations which is out of proportion to what might have been expected and which lasts for a considerable time. I believe this is partly due to suspended nutrition and I have attempted to combat it by full feeding up to and including breakfast on the day of the operation and by giving very small quantities of concentrated food early, starting between twelve and twenty-four hours after the operation. I have used for first meals with satisfaction the half of an egg white boiled, also the half of one boiled egg with a cup of very weak tea or hot water tea, either containing a small amount of sugar. If there is no disturbance this meal is repeated once or twice. Later on a very small piece of toast is added and then the regulation gruel and soft diet is resorted to. I believe that I get less fermentation from this feeding than from any other. Food is given at meal time only. At no time during convalescence are egg nogs or other sick-room drinks permitted at meal times or between meals.

I do not often allow patients who have had abdominal sections to sit up in bed at any time during convalescence, believing that acute flexion of the thighs promotes thrombosis. One to three days in advance of the time that the patients are to get up they are allowed to sit on the side of the bed with the legs hanging over for one to five minutes every three hours and they are soon asked to assist themselves in doing this. They are then asked to stand for the same length of time at like intervals, and on the same day or soon following are allowed to sit in a chair for 15 to 30 minute periods several times a day. I believe that this makes it possible to get patients out and around earlier than by any other practice.

As I have eliminated the hospitalizing of patients before operations and have simplified their preparation and ceased to use meddlesome postoperative therapy, I have observed that with each step there has been greater certainty of a smooth convalescence and little or no vomiting and very moderate abdominal pain in my abdominal sections.

At this time members of every vocation are expected to take stock and start anew. So long as the major portion of surgical work is really done by a large group of men who have not sufficient volume of it to justify their own group of helpers, would it not be a great step forward if in all large hospitals the preparation of patients, the anæsthesia, table nursing and first assisting were all done by stationary, trained help and that internes be generally given stationary services?

The internes and pupil table nurses are always enthusiastic and anxious to render efficient assistance, but are in truth but little help until near the end of their service. Our histories are sadly neglected and often entirely unreliable when written by the untrained men, and the operative and postoperative histories are rarely accurately written unless we dictate them ourselves. If they are to serve as records for any reason they must be accurately written. None of us doubts the good intention of both the new interne and pupil nurse but he are not often ready for the task they assume.

The question of pupil nurses serving at the instrument table as first nurse is altogether the most important one in the operating room technique that confronts us today. It is a heritage of the early days of training school work when considerable operating was done in homes both in the city and in the country. The demand for such a service at the present time is almost negligible. I believe that more than 99 per cent of the calls for graduate nurses today in hospitals and private practice do not require any particular surgical skill which must have been acquired as first nurse at the operating table. One always has a great deal of difficulty in getting the board of managers of a training school to accept this modern point of view, but it has been my observation that wherever hospitals have adopted the plan of having stationary nurses serve at the operating table they would feel that they were taking a step backward if they abandoned this plan. Nurses in training may get all of the knowledge they require by acting as secondary nurses in the operating room which gives them training in the preparation of supplies and detail work. They may be allowed to scrub and serve in minor operations and in certain major operations where two scrub-bed nurses are needed. I do not believe that a plan which is so harmful to the interest of patients and so wearing on surgeons should be continued.

Men seeking interneships are very apt to accept those offering rotating services, and many hospitals have held to this plan because they believed it to be easier for them to secure the best type of internes. While this plan has a certain advantage in giving men a variety of work, I do not feel that the length of service in any department is sufficient to impress them with its importance, to properly educate them or to infuse a proper spirit of enthusiasm.

THE USE OF AUTOMOBILE INNER TUBES TO PROVIDE LUNG EXERCISES AND TO MAKE ESMARCH BANDAGES AND TOURNIQUETS

By CARROLL SMITH, M.D., F.A.C.S., St. Louis, Missouri

ONE of the frequent causes of delayed healing of empyema cases is the failure to have the patient carry out suitable lung exercises. The reason for this neglect seems to be due to the fact that the method of blowing water from one bottle to another, and other similar procedures have not proved satisfactory. For some time, I have been instructing my empyema patients to blow up an old inner tube from which the valve has been removed. This exercise should be done several times daily after the acute symptoms have passed. I have found that this method gives better results than any other mechanical procedure and I am sure it has hastened the cure in numerous cases which have been under my care.

The usual commercial Esmarch bandages and tourniquets deteriorate rapidly. In using Bier's intravenous local anæsthesia, I have found great difficulty in keeping satisfactory rubber bandages. The idea occurred to me that excellent bandages and tourniquets could be made from discarded, automobile inner tubes. Bandages two or three inches wide may be cut from the tread surface or the valve-stem side of the tube. Such bandages are elastic, strong, and above all, durable. The rubber stands boiling well. One bandage which I have used for more than two years still retains its strength and elasticity. Narrow strips of the same material make excellent Esmarch tourniquets.

These two measures not only serve admirably, but in addition, the material is easily procurable, since discarded automobile inner tubes may be purchased for a nominal sum.

ADRENALIN

An Adjunct to and an Antidote for Apothesine

By HERBERT C. HAMILTON, Detroit, Michigan

ALMOST every medicinal substance is a potential poison and should be considered from this viewpoint. When for any reason toxic symptoms follow its administration, the physiological effects of a toxic dose should be known and information available as to a counteracting substance.

Under certain conditions local anæsthetics may produce secondary effects of an entirely different nature from their beneficial anæsthetic properties. In the case of cocaine the high degree of toxicity and its habit forming effects are such as to limit or inhibit its use in many cases.

Among the substitutes for cocaine, using the term in the sense of an equivalent rather than an inferior substance, novocaine for some years became very popular. Braun (1) states: "Experience and experiment have shown that by doubling the dose of novocaine so as to make it as effective as cocaine and at the same time by adding suprarenin (adrenalin), novocaine has become the ideal anæsthetic for injecting into the tissues and has made the use of cocaine unnecessary."

Attempts have been made in some cases to overcome certain of the objectionable features of cocaine by a combination of chemicals which will enhance its value, either directly as by applying the cocaine in its basic form, (2) or indirectly by localizing its action and so making a smaller dose more effective. Braun (3) says: "It was observed that the local anæsthetic power of cocaine was enormously increased by the addition of very small quantities of suprarenin."

Apothesine is a local anæsthetic which is materially less toxic than cocaine and is entirely free from habit-forming effects. By laboratory tests, approximating two of its methods of application — on the sciatic nerve of the frog and intracutaneously applied to human subjects — it is demonstrated to be equal to cocaine; in its action on mucous membrane, while less effective than cocaine, it is identical in degree and kind with that of novocaine (4). Its toxic action is also identical with that of novocaine showing a strongly depressing effect on the heart and respiration.

While local anæsthetics are ordinarily used

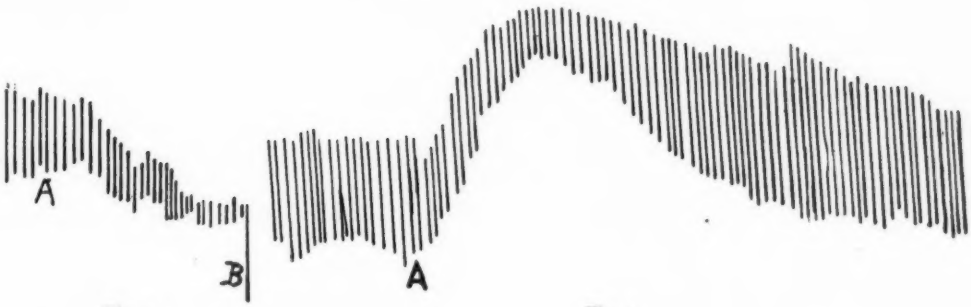

Fig. 1 Fig. 2

Fig. 1. *A*, Injection of fatal intravenous dose of apothesine. *B*, Death of dog.
Fig. 2. Injection of 0.00001 grams adrenalin as solution of adrenalin chloride at *A*.

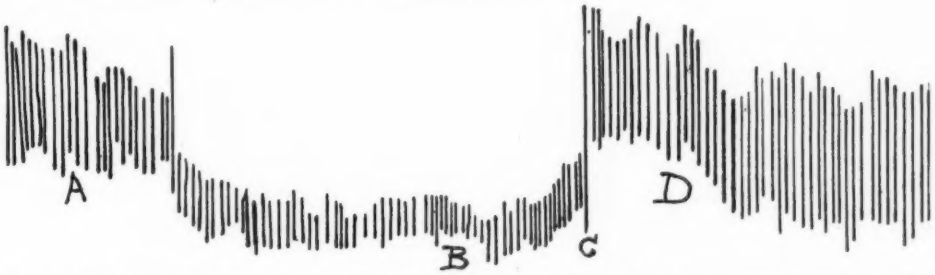

Fig. 3. *A*, Injection of 0.08 grams apothesine intravenously. *B*, Injection of 0.00001 grams adrenalin. *C*, After complete recovery, injection of 0.08 grams apothesine and 0.00001 grams adrenalin.

in doses minute compared to the amount necessary to produce a systemic reaction, there are occasions on which such reactions are evident either because of an excessive dose, or because of hypersensitiveness to its toxic action. In such cases knowledge of an antidote or counteracting substance is of primary importance, and should be in the hands of every user of the anæsthetic.

The minimum fatal subcutaneous dose of apothesine, based on guinea pig experimentation, is several times that for cocaine, that is, it is much less toxic. The fatal dose calculated to the average weight of a man is more than a half ounce of the pure crystals.

The toxic effects are exerted largely on the circulatory system. Blood pressure and heart amplitude are greatly reduced under its influence in animal experiments and death is apparently due to the depression of the heart.

What is therefore more natural than to turn to adrenalin, the characteristic effects of which on the circulatory system are exactly the opposite of those of apothesine and which when properly administered acts even more quickly. Experiments on anæthetized dogs confirmed this theoretical counteracting effect and proved, as shown by the illustrations, that an otherwise fatal dose could be favorably influenced by administering adrenalin chloride solution, and that when the latter was injected with the apothesine intravenously, its depressing action on the heart could be eliminated entirely.

Although in rare cases only is apothesine injected intravenously, its effect from this form of administration is much more rapid and is identical in kind with that from the subcutaneous injection, and is produced by a much smaller dose. The results, therefore, are comparable although the doses are not.

The experiments were carried out on anæsthetized dogs, the apothesine being administered intravenously on account of the promptness of its action when so given. The effect on the heart when so administered is so rapid that it was found necessary to mix the two substances since the one acts almost as promptly as the other. When the two agents are injected at the same time, the depressing effect of a large dose of apothesine is not evident until the action of the adrenalin has ceased to be a factor in sustaining the am-

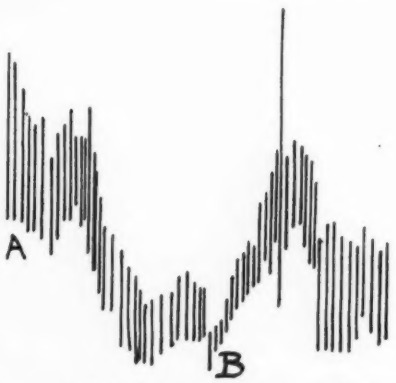

Fig. 4. *A*, Injection of 0.32 grams apothesine and 0.00001 grams adrenalin. *B*, Injection of 0.0001 grams adrenalin.

plitude of the heart beats and the blood pressure. When this occurs, due to an insufficient dose of adrenalin, a second small dose will restore the circulation to its former condition and sustain blood pressure until the toxic effects of the apothesine are gone, and the dog will remain in good condition.

The tracings shown are those typical of apothesine, of adrenalin, and of the resulting effects from judicious mixtures of the two: The dose of adrenalin which raises the blood pressure of a dog is 0.00001 gram or 1 mil of adrenalin chloride 1:100,000, a dose varying not so much with the weight of the dog as with the condition of the circulatory system. A dose ten times as great has a much more pronounced effect but not serious. From a mixture of the two intravenously administered and with a subsequent dose of adrenalin if necessary, blood pressure and heart action can be so controlled that no serious results follow the administration of a dose of apothesine which without the adrenalin would have been fatal within a short time.

The simultaneous administration of adrenalin with apothesine, as with cocaine and novocaine, is not for any purpose other than to localize and intensify the anæsthetic action, since its stimulating action on the heart and vessels is obtained only by intravenous injection. But the antidotal effect is indirectly effective even from the subcutaneous administration because adrenalin prevents general absorption of the anæsthetic and by intensifying the action of the apothesine makes large doses unnecessary.

The value of adrenalin, therefore, for both purposes, to limit absorption and to sustain the heart, is due to its characteristic properties of constricting the blood-vessels and acting as a prompt and powerful cardiac tonic.

NOTE.—At the request of the publishers the original tracings are replaced by line drawings to obtain better reproductions.

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TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING, FEBRUARY 6, 1919, DR. THOMAS J. SULLIVAN, PRESIDING

DUODENECTOMY, AN ORIGINAL TECHNIQUE

DR. JAMES J. MOORHEAD (by invitation). Below is an abstract of the paper read by Dr. Moorhead, regarding his technique in duodenectomy:

Is the duodenum one of the so-called vital organs, and if so, what is the nature of its vital function?

The author presented a preliminary report of work done on this problem, describing a method by which the canine duodenum may be completely extirpated. The operation is done in three stages:

1. The abdomen is opened through an incision 10 centimeters in length starting midway between the ensiform cartilage and the right costal margin; the rectus muscle is displaced outward; the left index finger locates the hepatopyloric ligament which is cut and the finger is passed downward behind the pylorus; the greater omentum is drawn to the left and an opening made through an avascular space in the dorsal mesentery close to the edge of the pancreas; rubber-covered clamps are applied on either side of the pylorus and four ligatures tied (two above and two below); the pylorus is divided on a Kocher director. The gastric end covered with a warm pad is laid aside. The mucosa of the duodenal end is dissected from the muscularis for a distance of about 3 centimeters and this isolated portion removed. The serosa and muscularis are infolded so that a portion of the pancreas covers the blind end. The transverse colon is located and drawn outward carrying with it the first loop of the jejunum. This is brought up in front of the colon and anastomosed to the open pyloric end of the stomach, the proximal part of the bowel at the lesser curvature. The abdomen is closed. A subcuticular stitch apposes the skin. No dressing is employed. Buttonhole silk is used exclusively in our work.

2. Two weeks later an incision similar to that described above opens the peritoneal cavity. The duodenum is picked up, the common bile duct identified and excised from the duodenal wall. The mucosa of the excised portion is completely removed. The opening made is closed by Lembert sutures. Wirsung's duct, which is the accessory duct in the dog, is ligated and divided. The gastrojejunostomy is located and a small opening made in the jejunum about 3 centimeters distal to the junction. The common bile duct with its attached duodenal wall, held by a thread armed with two needles, is drawn through an opening in the dorsal mesentery under the duodenum. These two needles are introduced into the jejunal opening and emerge about 2½ centimeters distally. Sufficient traction is applied to draw the duct through the orifice and the threads are tied on the serosa. One Lembert suture is used to effect closure around the duct.

The duct of Santorini is now found. Its usual location in the dog is at a point about 3 centimeters proximal to the place where the pancreas turns away from the duodenum. This duct is transplanted by the same technique as is the common bile duct, about 5 centimeters distal to the implantation of the common duct. The omentum is carefully arranged and the abdomen closed.

3. Following an interval of 14 days the abdomen is opened for the third time through the right rectus abdominis. Multiple adhesions are commonly found. The blind duodenal end is sought and liberated sufficiently to allow its being brought to an accessible position. The bowel is opened longitudinally along the surface opposite the pancreas for a distance of 8 centimeters. Hysterectomy clamps are applied parallel to and about 2 centimeters from the cut edge. With a sharp uterine curette the mucosa is completely removed. The wall is now divided immediately below the clamps and the remaining edges infolded with a continuous stitch. Proceeding distally, this technique is repeated until a point 4 cm. below the duct-bearing portion of the duodenum is reached. Beyond this point a typical resection completes the duodenectomy.

Advantages of this method. The gastrojejunostomy is made at the true physiological location, the pylorus. This region is undisturbed in the subsequent steps. The biliary and pancreatic secretions are preserved. The jejunum is made to serve as a substitute for the duodenum in receiving the digestive juices. So far as can be ascertained, the common bile duct and the major pancreatic duct have not heretofore been successfully transplanted into the jejunum at one time. Cholecystenterostomy in the dog is frequently fatal. Cholecystgastrostomy disregards well established principles of digestion.

Dogs so operated upon will live in normal state of health. The duodenum is, therefore, not essential to life.

DISCUSSION

DR. LOUIS D. MOORHEAD: In viewing the question of the duodenum from a physiological standpoint, two considerations present themselves: First, we may look upon the duodenum as a portion of the small intestine into which certain secretions are discharged and through which food passes during one of the stages of external metabolism. Second, we may look upon it as one of the so-called vital organs, possessing either a detoxicating function or else adding some internal secretion to the blood.

If we take up the first consideration, we find that the external secretions have been preserved even after duodenectomy and that the only change that has occurred is that a small part of a passage way has been lost. However, if we give our attention to the second point, we may determine first, whether the duodenum is one of the so-called vital organs, and second, if so, what this vital function may be.

What is meant by a vital organ is a moot question among physiologists. Some consider a vital organ one without which life cannot exist. Others consider a vital organ one without the functioning of which, certain changes, irremediable and characteristic, occur in the organism. As an example of the former, we have the parathyroids. It is known that if the parathyroids are removed, the animal soon shows characteristic changes which are irremediable, and in a short time the animal dies. As an example of the latter, we have the thyroid gland. If the thyroid gland is removed completely, it is not incompatible with life. However, certain changes, characteristic and irremediable, occur in the organism; we see the development of myxœdema, etc.

The duodenum is not a vital organ in the first sense, for life persists some time after its removal. For years the removal of the duodenum was considered incompatible with life, and Matthews, in 1912, confirmed this statement, but we now see that such conclusions resulted from imperfections in surgical technique. In the second interpretation as to what constitutes a vital organ, we cannot yet answer the question, for the number of experiments is not sufficiently large nor has enough time elapsed to permit conclusions. But we can say that the duodenum is apparently not an essential organ since no changes in the organism have as yet been noted after its removal.

DR. CARL BECK: Duodenectomy is a new operation, and Dr. Moorhead has worked out a method which can be repeated, after a number of experiments, with the greatest safety. As to its value, Dr. Moorhead has pointed out the physiologic importance. We know that a large number of operations of this kind have been done by Pawlow in the Physiologic Institute which have led to many physiologic facts that are valuable, and so it may be equally valuable to find out some facts from observing these animals in the course of weeks and months, determining whether the changes which take place are transitory or permanent. About this we can only philosophize or make hypothetical observations.

As to the practical value of duodenectomy, I do not know of any pathologic conditions of the duodenum of sufficient importance to warrant such radical removal. Carcinoma of the duodenum would perhaps be the only pathologic condition which would call for duodectomy and such a condition is practically unknown in that organ. I do not recall ever having seen a carcinoma of the duodenum and from my knowledge of the literature of the subject there are very few such cases reported. Of course, there are cases of tumor involving the duodenum, but these tumors are adenomatous in character, and we are able to resect the tumor from the duodenum without much difficulty.

One interesting technical point mentioned by the essayist is the transferring of the duct and the method described of doing it is interesting. Years ago I tried a similar method with the ureter; healing occurred very nicely without much discharge either from the ureter or the duct. The urine passed through without leakage. The serosa forms cicatricial tissue and makes a solid union. The constriction afterward is characteristic. In the ureter it leads to rapid disintegration of the kidney. The transfer of the ureter into the bowel is possible but it leads to stricture at the opening, and the stricture gradually leads to destruction of the kidney. This might be the case with the operation described; after a time there is apt to be constriction of the duct which leads to stricture and naturally to ascending infection in the liver, going up toward the gall-bladder in most cases.

DR. MOORHEAD (closing): Based on a considerable experience, I do not anticipate closure of these transplanted ducts, as stated by Dr. Beck. This does not happen if one transplants the entire duct including the papilla.

IRRITATION OF THE DURA OR INNER PERIOSTEUM OF THE SKULL

DR. CASSIUS C. ROGERS discussed the question of irritation of the dura and presented cases. (See p. 52.)

DISCUSSION

DR. EMIL G. BECK: I was pleased to hear Dr. Rogers repeat three times in his paper that the plates he exhibited were taken stereoscopically, and I agree with him fully that a single plate of the head is valueless. Unfortunately, in almost every meeting where X-ray plates are shown, single plates are exhibited, from which one cannot draw reliable deductions. For fractures the single plate may be good enough but not for chest or head work. I have been pounding away on this subject for fifteen years in trying to impress upon members of the profession the importance of having stereo-

scopic roentgenograms. If more physicians would take the trouble of having their roentgenograms made stereoscopically they would find it of enormous advantage in the treatment. In fractures and in pathologic conditions of the bones the finer points in the differential diagnosis can be cleared up only by stereoscopic pictures. This is particularly true in differentiating osteomyelitis, tuberculosis, syphilis, gonorrhœal arthritis, with destruction of the joints, etc. Even the expert is unable to make a diagnosis from a single picture in these cases unless the lesions are far progressed. When you compare the final changes in the bone seen by means of the stereoscope you will note the facility in making a diagnosis. I cannot too strongly endorse the use of stereoscopic pictures in all pathologic conditions.

DR. CARL B. DAVIS: I would like to ask Dr. Rogers if this woman from Detroit had spinal puncture and Wassermann tests made of the blood?

DR. ROBERT H. GOOD: In the last case reported by Dr. Rogers the patient, if I remember rightly, had several pieces of the skull removed and still had symptoms of extradural irritation. I have always thought that extradural irritation meant there was increased pressure in the skull; but with these pieces of skull removed, it seems to me the pressure could not be marked so that this case proves that we have these extradural symptoms without any special increase of pressure in the skull.

In the second case, Dr. Rogers made the statement that the temperature was normal. This was the mastoid case. I take it for granted that probably the temperature was taken only once at the hospital before operation. If the patient had been in the hospital for a day and the temperature had been taken every three or four hours, I think the temperature would have been found subnormal without a question.

My experience in these cases, as far as irritations from lime deposits are concerned, has been limited, but of irritations from frontal sinusitis and mastoiditis I have had twelve or fourteen cases, and the ease with which this disease is diagnosed is surprising; it is simple to make the diagnosis of extradural irritation. As to pain in a case of mastoiditis, sometimes the patient has none. Sometimes the pain is ordinary. If you make pressure on the mastoid, the pain is increased, but when we have extradural irritation we have a different proposition. Pain is intense. The patient complains of a constant pain usually, sometimes interrupted, and this pain is greatly increased if you make external pressure over the skull. In some cases of mastoiditis the temperature will vary from 99 to 103–4°, and as soon as we have extradural irritation the picture changes entirely. We have a subnormal temperature of 96, 96.7, and 97°. The pulse becomes very slow, as low as 55 and 60 when we have extradural irritation. The patient usually has projectile vomiting, a cerebral vomiting. In addition to that, there is usually dizziness, especially in frontal sinus cases which is present all the time. With mastoid involvement we have dizziness, also, but it is not as marked as it is in frontal sinus disease. The point brought out by Dr. Rogers is that the pressure is increased at the time of these dural irritations. The symptoms of extradural irritation, when we once know them, are easily recognized, and a great many of us fail in making a diagnosis just as was done in this mastoid case. It is very easy to diagnose these cases if one only remembers the symptoms of cerebral vomiting, slow pulse, subnormal temperature, and increased blood pressure, accompanied with slow cerebration.

DR. ROGERS (closing): I limited my paper to periosteal irritation of the outer layer of the dura only. Between the inner layer that comes in contact with the arachnoid membrane there is lubricating fluid; when this area becomes irritated, the patient manifests a different picture than we have had presented tonight.

With regard to spinal puncture and a Wassermann test of the blood, the patient not only had one spinal puncture but three Wassermanns made, each time and four of the blood, all of which were negative. Two of them were made by the same man, and the other by a man in Detroit. That does not mean, however, that the woman is not a syphilitic because she has a negative Wassermann either in the spinal fluid or in the blood. The temperature was not taken of the man to find out whether it fluctuated or not because he went to the operating room upon arriving at the University Hospital. I saw him there and within an hour after he was admitted to the hospital he underwent operation and was back in bed, so we did not have an opportunity to take the temperature repeatedly before operating.

PROSTATECTOMY COMBINING THE ADVANTAGE OF THE SUPRAPUBIC AND PERINEAL METHODS USUALLY EMPLOYED

DR. A. J. OCHSNER read a paper on Prostatectomy. (See p. 84.)

DISCUSSION

DR. DAVID W. GRAHAM: I have done the central perineal operation for removal of the prostate occasionally. But if the patient is one with a large pelvis and a thick fleshy perineum there is difficulty in reaching the prostate with the finger. Indeed the last time I tried it I failed utterly and had to make a suprapubic incision.

DR. E. J. SENN: I would like to ask Dr. Ochsner whether any sinuses have followed this method of operating?

DR. OCHSNER: Yes, I have had a few cases of sinuses following the operation, but they have been very few, and not as frequent as when I have operated suprapubically. I have one patient at the hospital now on whom a suprapubic prostatectomy was done elsewhere, and the sinus has persisted for twelve years.

OPERATING-ROOM TECHNIQUE AND AFTER-CARE OF PATIENTS

DR. COLEMAN G. BUFORD discussed operating room technique and after-care of surgical patients. (See p. 86.)

DISCUSSION

DR. CASSIUS C. ROGERS: There is one technique in the operating room I have noticed many a time, and that is, after a surgeon has washed his hands thoroughly and is about to put on a gown, he has his undershirt sleeves rolled up well above the elbow; after he has scrubbed his hands and forearm almost to the elbow, before he puts on a sterile gown he takes a sterile towel and dries the hands and forearm to the elbow, or three inches above where he has scrubbed, and the last thing he does with the towel is to dry his hands with it, so that the arm that has not been scrubbed comes in contact with the towel and the scrubbed hand, and the hands are in about the same condition as if they had not been scrubbed.

In regard to gas pains, if we did not give patients a cathartic before and after operation, but treated them all alike as if they were emergency cases, they would not have gas pains. If they do have pains, the best way to relieve them is to introduce a good sized rectal tube, leave it there, placing it in contact with the enema can that has normal salt solution in it and have for two or three inches the weight of the water going into the tube, having no clamp on the tube at all, and when peristalsis takes place it forces down the contents of the bowel, whatever it is, gas or fæces, so that it can pass through the rubber tube back into the can, and in that way patients cannot and will not have gas pains.

So far as the drop method is concerned, hanging the can up and dropping into the rectum water at a temperature of 105,° and letting it cool down to the temperature of the room. I believe it does harm and should be abandoned.

A patient should not have milk after laparotomy because ether is thrown off through the stomach, and if you put milk and ether together you know what happens. I do not think there is anything that will cause as much discomfort as a glass of milk the day after a laparotomy. In regard to irrigating the infected abdominal cavity, I see no use for it and it should in my opinion be abandoned.

DR. D. W. GRAHAM: I think about three-quarters of Dr. Buford's suggestions are very good, but some, of them I could not adopt at all. However, the trend of the whole paper is good in that it tends toward simplicity of procedure and dressings. Simplicity of technique is what all should aim at. It is singular how students, when taught a certain method of doing things, stick to it all their lives. It is hard to get them to make a change. An illustration of this is the instruction given in books and in the quiz room to apply big, copious dressings over a wound from which no discharge, not even a drop of blood, is anticipated. Just enough dressing to keep the patient from scratching the wound should be the rule for such wounds.

In regard to washing and shaving the parts, I want nothing more than tincture of green soap and a razor.

DR. CHARLES STOLTZ, South Bend, Indiana: I do not recall hearing a paper as refreshing as this for some time. I agree with Dr. Graham that 75 per cent of it is worth while; the rest of it, I should say admits of favorable discussion.

As to dressings, for instance, after a goiter operation, I use merely enough dressings to press my flaps down to the tissues underneath and after a few days none at all. In general I do away with dressings almost entirely. Granulating wounds, drainage wounds and filthy wounds, as a gangrenous appendix, do better without soggy, macerating dressings.

Dr. Buford's views on painting the skin with iodine seem to me in the line of progress. It has been an almost universal ritual. I no longer do it. We are constantly eliminating things that were standard a decade ago. If we did not make changes or modifications in our technique from time to time we would not make any progress. We must individualize.

Flushing the peritoneal cavity is a process that has very properly *not* been entirely abandoned. There is no better way to remove pus or débris located deep in the cul-de-sac than to flush it out by inserting a catheter or tube down to the bottom of the cavity. It is far gentler to flush a cavity than to mop it out with sponges.

I repeat, we must individualize. If we adopt a fixed rule and follow it in every case we run amuck, but if we look the situation over and use good judgment in the selection of resources we will be able to meet conditions.

DR. CARL BECK: Dr. Graham has said that 75 per cent of the statements made by the essayist are commendable. I should say, they are 100 per cent commendable — from the standpoint of the essayist—but there is more than one way to get to Rome, and if you get there it matters little how you get there.

In attending the clinics of different men we see surgeons go through a certain performance preparatory to and during operations, which may be simple or complicated, yet they all aim at the same thing. In looking at this subject in a charitable way, the man who adopts a certain method and achieves success by it, will naturally practice it. In short, every surgeon has his individual method or way of doing things, and all these different methods are good if they lead to success.

DR. CLIFFORD U. COLLINS, Peoria, Illinois: I was interested in that part of Dr. Buford's paper where he speaks of assistants and nurses in the operating room. I have been told during the last year, at least three times, by superintendents that

there is a law requiring that each nurse shall have had experience in presiding over twenty-five major surgical cases. I want to find out whether that law or rule was established by the training schools for nurses or by the Bureau of Registration. Such a rule or requirement is not fair to the patient. Such nurses cannot learn aseptic technique and develop a surgical conscience in that length of time.

DR. CHARLES DAVISON: The rules made by the training schools are for the interest of the nurses themselves, and not particularly for the interest of patients.

DR. A. J. OCHSNER: The nursing problem is an important one. The Board of Registration knew nothing about what should be done. They adopted eastern rules, called a number of superintendents and representatives of training schools together and made the rules these people wanted. I have recently analyzed these rules, and they are as Dr. Davison has said, not for the interests of patients but for the interests of the nurses themselves. It is for us to see that these rules are changed. There should be nurses with especial ability trained for the operating room, others should be trained floor nurses, others for obstetrics and again others for the care of children and so on. I have recently taken this matter up with the Board of Registration, and I find they had no idea in what a ridiculous position they were put. The Board made certain minimum requirements for nurses which, when added together, amount to thirty-two months, out of thirty-six months for the whole service, consequently these minimum requirements are fixed and the nurses have to conform to them and this leaves virtually no optional course. You and I have had so many other things to engage our attention, that we have not given the nursing problem sufficient consideration. From now on, we will have to do so.

DR. BUFORD (closing): I think that the society at some subsequent meeting ought to take some action by which the hospitals will be advised to adopt the plan of stationary service for first assistants in the operating room and stationary services for internes and table nurses.

I did not attempt in this paper to cover entirely this enormous field of operating-room technique, and after-care of patients. The time allotted me permits that I only touch upon the more salient points. From a practical standpoint these subjects have in some quarters become very complex and in my effort to show how much can be eliminated with safety and even benefit to our patients I have been quite conscious that many of you have been indulging in the same practices, but felt that if the question as we now view it, were summarized, that what you might add in the discussion and what words of approval or disapproval you might give to my remarks might be of some service to those removed from surgical centers who, in part at least, are guided by your opinions and practices.

Abdominal irrigation is not dead by any means. There are some very good surgeons who use it extensively, and I believe there is occasionally use for it, but I regard it as a thing which it is rarely necessary to resort to, and where I have seen it carried out the most it seemed to me that the patients were very much exposed to accidental infection through wetting of surrounding garments and back flooding of contaminated water.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD MARCH 7, 1919, DR. THOMAS J. SULLIVAN PRESIDING

AN APPENDICEAL ABSCESS

CARL G. SWENSON: The patient present has both mitral and aortic lesions and enlargement of his heart. The cardiac lesions developed after two attacks of inflammatory rheumatism. Following the first rheumatic attack, which occurred in May, 1906, the patient was ill for 8 months. Five years later, in November, 1911, he had another rheumatic attack which resembled the former and which continued for 6 months.

In January, 1917, the patient again became ill and consulted a physician who sent him to a hospital where he remained for 4 weeks. On several occasions during this time, another doctor of great ability was called in for consultation. Both doctors agreed that the patient had rheumatism and cardiac inflammation. He left the hospital on February 9, 1917.

On February 25, 1917, I was called to see the patient at a rooming house. My first impression was that he was seriously and hopelessly ill. His pulse was 120 to 130 per minute and it missed every third beat. The heart apex was in the axillary line, two inches below its normal position. Respirations were thirty per minute, and the temperature varied from 99° to 103° F. Examination confirmed the diagnosis made by the two previous doctors; however, they had never suspected that the patient might have appendicitis.

In addition to cardiac disease the patient had gastro-enteritis. His tongue was very thickly coated and resembled very much the tongue in typhoid fever. The abdominal muscles were very rigid

and the whole abdomen was symmetrically distended. Upon percussion a marked tympanitic sound was heard over the upper part of the abdominal cavity above the umbilicus. Below the umbilicus a dull and flat sound was discovered. He was unable to recall ever having had any appendiceal pain. His abdominal cavity became gradually more and more distended, and in the lower umbilical and hypogastric regions the dullness or flat sound increased daily. My treatment was chiefly directed toward the patient's gastro-intestinal disease.

He became desperately ill and was taken to the Passavant Hospital on March 24, 1917. Upon his arrival there I immediately took him to the operating room and did a paracentesis. An aspiration needle was inserted through the abdominal wall of the left rectus muscle at its most prominent part, at the junction of the unbilical and hypogastric regions. A very foul, thick yellowish-brown pus was found. The pus had a fæcal odor and I feared that I might have perforated the intestines.

On the following day, March 25, at 9 a. m., the patient was operated upon under local novocaine anæsthesia. A buttonhole incision one inch in length was made through the abdominal wall at the upper part of the left hypogastric region in the place of the aspiration. On opening the abdomen no perforation of the intestines was found. The abscess cavity which extended upward under and to the left kidney, and downward to the rectum, contained three pints of thick pus. It required one hour for its evacuation. By inserting my left forefinger into the wound I found a round channel, containing pus, leading across the hypogastric region through the omentum toward the right inguinal region. The patient made a rapid recovery and the wound healed in four weeks.

The discovery of the pus-filled, internal abdominal sinus leading to the appendiceal region, seems to confirm my diagnosis of an appendiceal abscess.

Dr. Christian Fenger had a similar case which I saw him treat in the Passavant Hospital. He first aspirated through the abdominal wall and then incised the abscess through the rectal wall.

COMBINATION TREATMENT OF SURGERY AND DEEP THERAPY OF INOPERABLE DEEP-SEATED CARCINOMA

Dr. Emil G. Beck: This is a preliminary report on some experimental work which has been done during the past two years at the North Chicago Hospital on apparently hopeless cases of recurrent, deep-seated carcinoma. Each case in which the treatment has been employed has had at least one or more surgical operations, after which recurrence has taken place and in which no further surgical or any other treatment has been thought of avail.

The treatment consists of a combination of radical surgery with deep therapy. There is nothing new in this procedure for surgeons for many years have advised treatment with following up the removal of malignant growths by deep therapy, and no doubt a great deal has been accomplished with this method. The feature which I desire to bring out is this: to prepare the field for the roentgen or radium treatments by intentionally exposing the malignant area after recurrence has taken place, by the most radical removal of all overlying tissues.

It is a well known fact that superficial malignant growths, such as epithelioma, respond readily to roentgen-ray and radium treatment, while the deep seated growths do not. The reason for this may be found in the suggestion that the skin, fat, and subcutaneous tissues, which usually overlie deep-seated cancer, are filters preventing the penetration of the roentgen-ray. These tissues absorb nearly all but the hard rays from the roentgen-ray tube, or the γ-rays from the radium. Thus only a small quantity of the rays will penetrate deeply enough to reach the growth and the power is so diminished that instead of destroying the cancer cell, the rays may stimulate the tumor to more rapid growth.

It, therefore, occurred to us that, if we could remove the skin and all the overlying tissue and as much of the growth as feasible and leave a large area entirely exposed and then apply either the roentgen-ray or radium directly on the open wound, no matter how large it might be, we might obtain results similar to those obtained in treating superficial growths.

The physicists teach us that the rays emanating from radium consist of three varieties: α, β, and γ rays. The α-rays constitute more than 92 per cent of all the rays emanated from radium, the β rays about 5 per cent, and the γ only about 3 per cent. The α-rays are very readily absorbed by thin metal foil or even by the air. Rutherford says that a thickness of 6/1000 of aluminum or mica, or even a sheet of ordinary writing paper, is sufficient to absorb completely all the α-rays. A great many of the β-rays are absorbed in 5 millimeters of aluminum or 1 millimeters of lead. Only the γ-rays will penetrate such filters. As a rough working rule, it may be taken that thickness of matter required to absorb any type of ray is inversely proportional to the density of the substance.

The β-rays, however, are about one hundred times as penetrating as the α-rays, and the γ-rays are from ten to one hundred times more penetrating than the β-rays.

The density of tissues depends upon the close packing of the molecules which compose them. In fat, for instance, the molecules are very far apart, while in the skin or muscles they are more closely packed, and in metals, such as lead or silver, the molecules are extremely dense. The shadows on the photographic plate of these different substances give us an approximate indication of the molecular composition. Lead will produce a very dense shadow, while wood or muscle give correspondingly lighter shadows.

It is well known that the skin itself is quite an obstacle to the penetration of the roentgen-rays; it produces a shadow on the roentgen-ray plate and some authorities have stated that more than one-half of the β-rays are absorbed by the skin, and where the underlying tissues, such as muscle and fat, and fascia, absorb still more of the rays, it is most likely that very few of the β rays ever reach the deep-seated tumor. Thus, we deprive ourselves of the greater quantity of the rays emanating from the radium. Even the γ-rays lose some of their intensity in passing through the skin and subcutaneous tissue.

Taking these physical characteristics of the rays into account, I have, therefore, concluded that in order to have a full measure of the effective roentgen-rays reach the tumor, we must remove the obstruction to their passage; namely, skin, muscle, and as much of the tumor as possible. The procedure will be best understood by the demonstration of cases. It is based on scientific principles and while the number of cases thus far treated are not sufficiently large to draw from them definite conclusions, they are encouraging enough, considering the hopelessness of these cases, to justify its application. Usually the patients are perfectly willing to undergo one more operation, because they have lost all hope of getting well.

A great many questions are not entirely clear in regard to the effect of the roentgen-ray treatment. For instance, the question as to why the roentgen-ray will destroy the cancer cell much more quickly than the normal tissues. We have noticed that the cancer growth diminishes while the surrounding healthy tissues are not materially affected. This question has puzzled many pathologists and roentgenologists and some interesting theories have been advanced. I have a theory of my own, for which I have no scientific proof, but which is interesting and I believe worthy of consideration; namely, that the cancer cell is dissociated from the central nervous system, that it grows wildly without regard to structure, and appropriates its nourishment from the blood stream and thus grows very rapidly. Nearly all cells which compose the human body serve a function and the nutriment they receive is a sort of compensation for their work, while the cancer cell steals it nutriment, giving no counter-service to the body. And likewise, it does not receive the same protection from the body as the cell which is under the control of the nervous system. Is it not possible that the healthy cell belonging to the body has a certain immunity against all injury, including any ill effect from the roentgen-ray?

What becomes of the large denuded surface after the growth has apparently disappeared? The skin from the borders of the wound will gradually grow from the edges and cover the entire surface, with the aid of the adhesive plaster method, which I have demonstrated before the Society. This in itself is a proof that the growth has been eliminated, because healthy epithelial cells will not grow over cancer tissue; but I have observed in the cases which I have treated that the skin will cover large surfaces which formerly occupied masses of cancerous tissue.

Whether there will be any recurrence of metastatic tumors in other parts of the body, is another question. It is possible there will be. The susceptibility to cancer recurrence in what is called a cancer individual may still remain even if the growth in a particular region is destroyed. It has been stated by some observers that there are various changes in the entire body after roentgen-ray treatment, which may prevent a recurrence, but this is too large a subject for discussion at this time.

I present this subject in this immature state, merely that others may try it and help in perfecting the surgical as well as the roentgenologic technique. It certainly can do no harm to these poor individuals, who have nothing but misery and death to look forward to.

My first patient I treated three years ago. I operated upon this patient for carcinoma of the breast and left the surface open; I used the roentgen-ray directly on the exposed wound.

Two years later this patient returned complaining of headaches, and my brother, Dr. Joseph Beck, who had her under his observation, suspected a recurrent carcinoma in the brain. She would not consent to operation, and we do not know whether she had a recurrence or not.

A second case is that of recurrent carcinoma of the neck in the submaxillary gland. The patient had been operated on three times previously, and had had a rapid recurrence after each operation. She had received roentgen-ray as well as radium treatment in our hospital for a long time, without any apparent result. She had lost much in weight. I finally decided to excise widely and apply the rays directly to the growth. After resection of the entire tumor, I made the skin flap and shifted it underneath the jaw. I left the entire site of the tumor exposed. After two months' treatment the skin had grown into the entire cavity, and the patient has had no recurrence now after 10 months.

The third patient is a woman physician who has cancer of the breast. About six or seven months ago, I removed the growth up to the clavicle and resected the glands underneath the clavicle. I sewed up the entire wound. She already has had a rapidly growing recurrence above the clavicle. I resected all fat, glands, and skin above the clavicle, exposing the clavicle. I left open a space, 4 by 6 inches and very deep. Four weeks after the operation we applied one roentgen dose daily. It would be dangerous to apply the rays daily to the skin. We have given seven roentgen doses in seven days, and the entire cavity has filled up and has become almost covered with skin. The patient has gained 4 pounds every week since this applicaton of the roentgen-ray.

I am very glad to be able to show this very typical

case, an epithelioma of the scrotum. The patient was operated upon last summer. He brought me the section of the first tissue which was removed. Soon after removal the glands in the groin began to enlarge; carcinomatous recurrence. The patient was operated upon a second time, and I saw him first six weeks ago. At that time he had a large, hard mass with a deep crater, and with typical infiltration in the groin. The case was pronounced hopeless. The entire groin was one hard mass, he could hardly lift his limb, and was very weak.

I did a very extensive removal taking off part of the abdominal wall and making a wound of 12 inches in length and 8 inches in width. I removed all tissues down to the vessels. Although the excision was deep, I could never see the vessels, because they were all involved in the growth.

At this time the wound has diminished to about one-half its size. I resected the testicle. The patient is now able to raise his limb, and can walk.

He has gained in weight and health. The bluish border of the wounds is the new skin growing. We employ the adhesive plaster method for regeneration of skin. The yellowish gray discoloration is from the effect of the roentgen-ray. The patient had a treatment this morning. The roentgen-ray in these doses produces a sort of necrosis, similar to a diphtheretic membrane, which almost can be peeled off.

DISCUSSION

DR. A. J. OCHSNER: Some years ago Dr. Crile wrote a number of papers in regard to treating malignant growths of the neck as described by Dr. Beck tonight. Since that time we have used the method in many different locations; in breast cases, for instance, we never graft skin immediately, but give very intensive roentgen-ray treatments for a week and same treatment on the open wound with the rays after operation. I am sure that, by this time many of our patients are now alive who could not possibly have lived without this roentgen-ray treatment.

There is no doubt at all that carcinomatous tissue will not stand severe roentgen-ray treatment; that is, you can apply the rays very intensively, just short of killing the patient and save many patients who otherwise would be in hopeless condition. Most of the patients shown by Dr. Beck I am sure, would be dead now, if it had not been for this treatment.

We had a very interesting case two years ago, a sarcoma of a non-descended testicle. I did an abdominal section, removed the tumor and found that secondary growths had extended up the entire side. I did as complete a removal as possible but I found there were nodules around the kidney. The case seemed absolutely hopeless. At the same time we thought it worth while to try the roentgen-ray and gave him very intensive treatment, using a thick aluminum filter, so that we could filter out the rays that were likely to burn the skin. To our surprise the carcinoma has not progressed, at least up to the present time. The patient is a clerk here in the post office. He was able to go back to his work within two months, and he has worked nearly two years since. We evidently killed the sarcoma, or at least we retarded it so that he has lived at least a year and a half longer than he would have lived without this treatment.

In the old days, when we used the little coil made by the American X-ray Company, we had a recurrent case of carcinoma of the breast with an involvement of the supraclavicular glands and with protrusion of the eye. We used the roentgen-ray very extensively, and the patient became more and more emaciated, weak and cachectic. We used that little machine, which seemed to be a plaything. I sent the patient home presumably to die with the eye still protruding. The next time I saw her a year later the eye had returned to normal and the case was apparently well. I have not followed her now for some time, but she came in occasionally during the next few years, apparently well. So I am sure that in some of these cases that seem hopeless the roentgen-ray kills the malignancy.

DR. A. E. HALSTEAD: My experiences with the X-ray in recurrent and deep-seated carcinomata has been unfortunate. I have never had a case that recovered; nor that improved very much under treatment with X-ray or radium. The same has been true of sarcoma. One of the last cases I had before entering service was a woman who had very extensive sarcoma of the thigh. With the help of Dr. Case, we gave this woman enormous doses of radium. Dr. Case had me make deep excisions into the thigh, down to the femur. This was a sarcoma of fascia origin, which had invaded the femur. We gave her doses that caused extreme constitutional symptoms. These doses were repeated at intervals of seven days. In spite of this treatment the disease progressed unfavorably, and ultimately caused death a few weeks after the radium treatments had been discontinued. In my experience I have never seen a sarcoma that was cured either with the roentgen-ray or radium. I have seen carcinomata, a few, that seemed to improve, and I have seen some epitheliomata of the skin get well; but a deep-seated carcinoma, or a sarcoma, I have never seen get well or improve under roentgen-ray or radium.

DR. W. R. CUBBINS: I worked with the roentgen-ray when I first started out in practice. While I have not had any patients who have lived any great length of time, I firmly believe that I have had several whose lives have been prolonged by the administration of the X-ray. Only in two cases was it used in places where the skin had not closed over. The skin was not closed over in those cases, because there was not enough left, after the operation, but we applied the ray heavily. Both patients lived several years. I believe there is much to be done along the line of opening up the wound and applying roentgen-ray, to the deep parts.

DR. BECK (closing): Carcinoma does not require the removal of the skin. Carcinoma reacts to the roentgen-ray much more quickly. This is especially true as regards carcinoma of the glands, and especially lymphatic sarcoma; therefore I would advise the usual treatment in sarcoma.

But the roentgen-ray alone would not have cured those cases which I have demonstrated. I have just given the reason why they would not. The gist of the whole thing is the removal of the skin and other tissues before the application of the roentgen-ray.

When we operate on a case in the breast, we leave a little window there that is not big enough perhaps; the opening must be large enough so that the roentgen-ray can penetrate all spaces affected. There is no reason why we should try to save skin in a hopeless patient, for the skin will regenerate, if the patient is cured and, if he dies, he does not need the skin.

In case of sarcoma of the thigh, treated by the roentgen-ray, I can see why the case which Dr. Halstead cited has not improved. Bone sarcoma resists this treatment. One must not be discouraged because he has not cured every case of carcinoma where he employed deep roentgen therapy.

Even without removal of the skin, by proper application, Dr. Pfahler, of Philadelphia, has cured a large number of cases. With a patient who has nothing but misery and final death before him, why should we not go to the extreme and see what can be done with the method which I have just brought before you.

PLASTIC SURGERY ON THE HEEL

DR. B. F. LOUNSBURY: During the past five years I have had occasion to care for three unusual cases of injury involving the heel. The damage sustained was of such a character as to wholly incapacitate the man from physical labor, yet was not severe enough to warrant an amputation of the foot.

The problems to me were unique and it is because of the unusual features of the cases that I thought them of interest enough to present to you. A brief history of the cases with the methods employed, are as follows:

Our first case received an injury in 1913 which crushed the lateral side of the foot, destroying the distal end of the fifth metatarsal and little toe and tearing away the entire pad of the heel and crushing the posterior tip of the os calcis. The ankle-joint and other structures of the foot were intact and the doctors in charge hoped to save a useful foot. At various times skin grafts were applied until all the raw surfaces were covered. It was found, however, that an area over the end of the os calcis persistently broke down and remained as an open ulcer. The foot was in this condition in June, 1914, when he came under our care.

I had never before transplanted a flap over the end of the heel, but after placing the foot in various positions, decided that a flap could be elevated from the back of the thigh. This was done and the heel was held in a cast against the back of the thigh for 14 days, when union was firm enough to cut away the flap. Ultimately an excellent covering was developed for the heel. When the patient was first permitted to step on the foot, he was provided with an arch support which helped to take some of the pressure from the heel. In September, 1915, he was again able to resume his work and has never been obliged to lay off a day since that time on account of any trouble with his heel.

Gradually the transplanted skin has toughened to meet the demands of the pressure placed upon it and he now has a very excellent weight bearing surface in this transplanted tissue.

It was necessary to place the patient on his face with his leg crossed behind him and hold him in a cast. The discomfiture from this was extreme, and I thought at the time, if occasion ever arose for a similar operation, that I should try to avoid keeping him on his face, as the position was difficult for the patient and made it difficult to care for him.

In January, 1916, we received another patient who had the right leg crushed below the knee and his left heel crushed. The os calcis was cut through, about midway between the anterior and posterior ends. The entire padding and soft tissues about the heel were destroyed. The question arose at that time of amputating the foot, but the doctors in charge decided to try to save it. The patient came under our care some time later, with an ulcer on the heel which could not be covered with skin because of the dense scar tissue. Two and one half years after his injury he was still unable to use his foot and was walking with an artificial leg and a pair of crutches. In July, 1918, we performed a flap operation to cover the heel. Hoping to obviate some of the difficulties encountered in the first operation we sat the patient up and crossed his legs in front of the thigh, holding it in a cast.

This was a great improvement so far as the position of the patient was concerned, but we found later that the pressure of the external malleolus over the front of the thigh was so great that it produced a necrosis that reached to the femur and necrosed the skin over the external malleolus.

It was necessary to take a large amount of flap away, in order to cover this defect over the malleolus. Subsequently we skingrafted the area over the front of the thigh and there has been a full restoration of the function of the quadriceps muscles and tendons.

About six months following this operation, a case was brought to my clinic in County Hospital for a curettement of the os calcis because of a persistent ulcer on the heel. Inquiry into the history showed that the patient two years previously had had the end of his heel crushed off in an accident in Mexico and though skin grafts had been applied,

an area of about one inch in diameter remained as an open ulcer. A roentgenograph showed that the periosteum over the end of the os calcis had been damaged and had produced a thickening in this region.

We decided that the only way to get a serviceable foot was to put a transplant over the denuded area. With our experience in the two previous cases we hoped to make this patient the most comfortable and avoid the sloughing which took place in the second. We turned up the flap from the front of the thigh, but padded well to keep pressure off the external malleolus. We found when ready to cut the flap down, in spite of all our precaution, necrosis had taken place as in the second case. Despite this we have secured a healing which now seems certain to give a good functional result.

Dr. Carl Davis: I have had but one case similar to that which is mentioned. Our patient was a stocky, heavy muscled individual, and as we drew out his leg in the various positions it was seen at once that the foot above the knee would cause him much pain. We applied a plaster cast before the flap was removed as an experiment to see how he would stand the position. We were compelled to take off the cast in a few hours. We eventually compromised and brought the heel up to the middle of the leg and took the flap off the calf. If you will place your own foot in this position you will see it is not trying, and it worked out well with our patient. We kept him under observation for a year. The distal portion of the flap did not heal well, and gradually the plantar fascia grew backward. It was the most remarkable case of regeneration I have ever seen. It made me think of the experiments we used to have in zoology where we cut off the antennæ and nippers of the crawfish to see how far back we could go before regeneration failed.

The original lesion in this man was due to a railroad accident where the plantar surface of the os calcis and most of the soft parts of the sole of the foot were crushed off. When he was finally discharged from observation the flap which we had taken from the calf had diminished in size so that it was not much larger than a silver dollar. The plantar fascia had regenerated for a distance of almost three inches.

Dr. Emil G. Beck: I only wish to say that the os calcis, can be removed especially in cases in which the disease has destroyed the bone entirely, or partially. Even after complete removal of the os calcis the patient may in time have a useful heel. There seems to be a tendency of the os calcis to regenerate, just as after removal of a rib, another rib will soon grow in its place. The growth of new bone is probably due to the fact that there remains in the surrounding tissue some parts of the periosteum. I have two such cases, and there seems to be almost no deformity left.

Dr. Charles Davison: It was my opportunity to be an interne in the service of Dr. Christian Fenger, and to see some of the earliest successful flap plastic work done by him. I have since done quite a bit of this work. I remember my first case in which the patient had lost the heel. In that case I took the skin from the dorsal part of the foot and turned it down as a flap. The flap was not thick enough to give as good a result as I wished, but it was successful and the patient is walking today.

The next case I treated according to the method described by Dr. Carl Davis. I put the heel to the calf of the opposite leg. That is the method I have followed since. I have not found that the patient suffers a great deal with the foot in that position.

I have put the patients in very solid plaster casts, encircling both legs so that they are solidly attached to each other, when there is no movement. There is little pain. I think that all of these years have demonstrated very thoroughly that the Thiersch graft, or any thin graft will not stand the attrition of use on the sole of the foot or on the palm of the hand.

There is a patient today in my ward at the County Hospital who illustrates that very nicely. He is an old chronic, 60 years of age. Twenty years ago he had a railroad accident in which his heel was crushed off, in much the same manner as in the case that was shown tonight. A skin graft by the Thiersch's method, was applied and the wound was successfully covered. However the patient walks for only a little time until the heel grows ulcerous, and then he rests the foot until it heals over again. He has repeated this history for twenty years.

Dr. Carl Beck: The results that Dr. Lounsbury has had are really marvelous considering the location of the transplantation.

Good results for transplantations can be secured only when tough skin is used for the transplant.

A method which I have used and which was originally described by Shrady, of New York, many years ago, gives excellent results. A flap is transplanted first to the arm, where it is left long enough to establish good circulation. It is then transplanted to the heel; merely transferring the flap from one position to another, through the medium of another locality. I have used this method several times and it works very well.

Dr. A. E. Halstead: We have had a number of these cases, and never had any difficulty in getting the flap from the inner side of the thigh. I put the patient in a cast, incorporating a piece of wood in the cast to support the leg. I had two cases of malignant disease of the heel, one a carcinoma in an old woman, and the other a sarcoma in a young man. In both cases I amputated the heel cutting through the os calcis, and soft tissues. A peduncular flap was lifted from the inner side of the opposite thigh and the elevated margin attached to the heel. At the time the flap was detached from the thigh a piece of fat was inserted under the flap to serve as a cushion and protect the flap

from pressure. In the case of the man the mammary gland was utilized at a free transplant. In the woman a piece of fascia and fat was taken from the buttocks.

In two cases of traumatic loss of the heel, like these shown by Dr. Lounsbury, I did the same operation, using the flap from the inner side of the thigh. I have never had any difficulty and never had any patient complain of any pain or discomfort from the position of the foot.

Contrary to Dr. Beck's statement, I believe, that skin from any part of the body, if you remove with the skin the underlying fascia, will be sufficient covering for the heel, if underneath you place a cushion of fat. Skin very quickly assumes a rugged character and becomes thick.

DR. DAVIS: I think Dr. Beck misunderstood me. I transplanted from the rear of the calf, to get plenty of fat.

DR. LOUNSBURY (closing): Dr. Beck speaks of taking a transplant from the arm. My objection to this would be that we would run the chance of putting quite a scar on the forearm. In one of these cases, we had to have a very large flap to cover the heel. The flap would probably be as large as the whole forearm. In transplanting these flaps, I find that as soon as the skin is turned up from its normal position, it shrinks very materially and much would be lost by shrinkage unless the flap were transplanted and held in its new position by sutures.

DR. CARL BECK: I do not mean to take the flap from the forearm, but to take the flap first from the thigh and transplant it to the arm. That does not take anything away from the arm.

DR. LOUNSBURY: I will bear Dr. Beck's suggestion in mind in case I have occasion again to treat such a condition. My reason for selecting the thigh instead of the calf of the leg was that fact that a thicker pad of fat could be secured in the thigh than in the calf. I presume fat, however, could be supplied from other sources as has been suggested.

The pain these patients suffered, however, from holding the heel to the thigh was not intolerable and the young Mexican, who was rather loose jointed, complained very little. The other two men, however, required considerable opiate.

AN ADVANCE IN THE TREATMENT OF DIABETIC GANGRENE

DR. L. L. MCARTHUR: Four years ago I brought to this society nine cases of gangrene of the foot of the type of thrombo-angeitis-obliterans. These nine cases had been cured, their gangrene checked, their line of demarkation formed, and the feet made well without amputation.

Since that time, by the application of the treatment which Koga has recommended for that form of gangrene of the young, I have experimentally tried the Koga method in cases of diabetic gangrene that have been transferred from the medical departments of the hospitals with which I am associated. To my surprise, I have found that the same effect holds true in diabetic gangrene as holds true with the thrombo-angeitis-obliterans. In August of last year I took to the Tri-State Medical Society, at Madison, Wisconsin, illustrative cases of diabetic gangrene, which had been so cured. I had two cases for exhibition at the clinic this morning.

For the benefit of those who may not be familiar with the treatment that Koga recommended, I would like to epitomize it briefly.

Mayesima, pathologist in the University of Tokio, showed in 1910 and 1911 that all cases of gangrene had an elevation of the viscosity of the blood. Acting on the hint contained in this contribution to the experimental research by Mayesima, Koga tried to reduce the viscosity of the blood.

Posseulle had shown, in the experimental laboratory and in the physical laboratory, that the flow of fluids through capillaries is inversely proportional to the square root of the viscosity of those fluids. If the viscosity of the blood is reduced one-half the flow is doubled. In other words, a capillary will be multiplied four times in functional capacity by reducing one half the viscosity of the blood flowing through it.

The result of Koga's experiments were presented to the Japanese Surgical Society in 1911, with thirteen cases cured, one to three years, with two recurrences; and cured simply by arresting any further progress of the gangrene, lifting off the dead tissue when the line of demarkation had formed, or if the end of a phalanx or metacarpal bone stuck out, amputating that with the bone scissors.

In Michael Reese Hospital, where cases of thrombo-angeitis-obliterans are more frequent than in the other hospitals of our city, because the disease is one peculiar to the Jewish race, opportunity came to me to try out this treatment. The results have convinced me that it should always be tried before resorting to amputation in any case of gangrene of the thrombo-angeitic type; with the exception that if the patient be profoundly toxic, from not only the gangrene, but the absorption of mixed toxins, associated with the gangrene, then it might possibly be not safe to try it.

Dr. Edwards referred to me for amputation, a case of diabetic gangrene with profound sepsis, high temperature, soggy and infiltrated foot and calf of the legs—a delirious almost unconscious patient. The patient was in such desperate condition that I felt justified in waiting and while waiting trying the Koga treatment.

Koga found that by simply diluting the blood by hypodermoclysis, with a thousand cubic centimeters of ordinary salt solution, he could dilute and thus reduce the viscosity of the blood so markedly, as measured by the viscometer, that he decided to try it in the gangrenous cases mentioned. By using it once a day for two or three weeks, and then every other day, then two or three times a week, he secured his results.

Trying this same plan on a diabetic then, with local antisepsis, and the crowding of his vessels with fluids, three liters a day, we succeeded in producing a line of demarkation on his foot. It ultimately healed and he was able to use the limb to walk on.

Having that success, the next cases of diabetes that I saw I also so treated. I reported the result of four such cases at the Great Lakes symposition. In the course of the past four or five months I have had five more; so that I now have nine cases of diabetic gangrene, in which the line of demarkation has been outlined—the ultimate sloughing off of the dead tissues from the living—the starting up of a suppuration, not seen with the untreated thrombo-angeitis, nor with the diabetic gangrene, but the actual formation of pus, and that process which accompanies the formation of a line of demarkation, we succeeded in obtaining. It is, then, to encourage the trial of this treatment before resorting to amputation that I appear before you.

Time after time we have all of us amputated these gangrenous limbs, we have always felt that if two or three toes or the major portion of the foot were infiltrated, we should amputate to the lower third or to the middle of the leg to secure a proper area for amputation. This kind of feet we have sacrificed, but I can now show men able to walk around upon cured feet of this kind.

It looks then a simple procedure, and you all feel at once that you will adopt it. Don't adopt it however, if you do not intend to give it a fair trial. It means from ten to twelve weeks of treatment. The earliest that we have gotten results is in 42 days. It means a long, tedious process; you will find, as I found, that there will be considerable difficulty in getting your patient to submit daily for the first two or three weeks to hypodermoclysis of a thousand cubic centimeters under the skin of his breast, or his chest. You will have to find some other way, as I did, and make your injection into the veins of his arm. But after you try that for three or four weeks it is difficult to puncture the veins. Then what will you do?

An interne of mine, Dr. Davenport, suggested, that we adminster the solution through the duodenum, using the Rehfuss tube, that is, have the patient swallow this very small Rehfuss tube, inserting it down to the second marking on the tube, which means that it is almost in the duodenum. With this method we found we could put in a litre of solution three or four times a day. The patient could sit and smoke a cigar, or read his paper an hour or so after he had his meal, without any interference with the digestion and without the fullness that would come from swallowing the water, glass by glass. After one has taken two glasses of water he begins to feel uncomfortable, and after three or four glasses are taken there is distress in the stomach. We have had five patients at a time sitting and gossiping, all of them taking this treatment, and all perfectly happy, except for the fact that they had to urinate frequently.

Koga recommended the use of normal salt solution. I believe that Locke's or Ringer's solution is an improvement on normal salt solution. While diluting the blood to reduce its viscosity, the blood is robbed of those chemical elements which can very readily be incorporated with the salt solution, by using the normal physiological solution of the laboratory.

In the past three months I cared for a patient who had been rushed across the continent because the surgeons of California concluded to amputate his foot, on account of the impending gangrene of diabetes. We have all seen the little dark spot on the soft tissues, and the coldness and poor circulation and the pain which impends before gangrene comes. Just then is the time in which to save perhaps, the patient's life, but surely a toe or two. This I have done three or four times in the last 3 or 4 months. I am sure that you will find it quite possible to do so.

In two cases of diabetic gangrene I have not had good results. In these cases I found on taking X-ray pictures of the limb which had to be amputated afterwards, that the arteries were perfectly calcareous, pipe stems. In such cases I do not believe one can hope to change the circulation sufficiently to secure a favorable result; I would, therefore, suggest that prior to beginning treatment which must necessarily extend over a period of a number of weeks, that an X-ray picture be taken of the diabetic gangrene extremity. These calcareous blood-vessels are so reduced in caliber, that you cannot hope to accomplish much.

However, in the diabetic of the younger period of life, where there is absence of the calcareous changes in the arteries, you still have the comfort to know that many cases can be saved. I hope you will try it.

DR. MCARTHUR: I have been asked what effect this flushing of the vascular system in the kidney had on the diabetes. I meant to say that the sugar is washed out of the blood in great quantity and diminishes and disappears far more rapidly than by the simple dietetic treatment. Undoubtedly the carrying through the kidneys and through the skin and through the bowels of such large quantities of fluids dissolves the sugar and carries with it, as it passes out, the sugar which is making the increased viscosity of the blood, and causing the gangrene.

Since starting this treatment and calling my medical colleagues on the hospital staff into consultation on it, some experiments have been made with the blood of these thrombo-angeitis cases; and, while they show no sugar in the urine, they have a hyperglycæmia, an increased amount of sugar in the blood, which is rather an interesting observation; and, although they do not show it in the urine, they have above the normal amount in the blood.

Dr. Halstead spoke of gangrene of the leg. I have been referring more particularly to the early gangrene of the diabetic type and the gangrene of the foot. When the gangrene has spread also

to the leg, I imagine that amputation will be the better procedure.

I want particularly, however, to emphasize the importance to your patient of the first sign, when he comes to you, of that little black spot on one side of his toe or under his toe, and the impending gangrene which is there threatening; because then you really protect him from the disaster which ultimately overtakes him if this be not recognized.

Now as to the gangrene that comes from the arteriosclerosis. Gangrene unfortunately is associated in all of your minds with a change in the blood-vessel condition. We have always thought in blood-vessels when we have thought of gangrene. We must now, however, think of changes taking place in the blood itself, and not particularly in the vessels; but changes in the blood will make the gangrene; changes in the innervation will make the gangrene; changes in the vessel walls will make the gangrene. There are three different things to be considered: viscosity, vessel walls and the innervation.

Now, I do not think there is any reason why the patient may not drink this fluid; and two of these nine cases have been able to get their three quarts of water by drinking. Those who have tried it have had to force themselves, however, to a considerable amount of discomfort in taking fluid through the stomach without the tube. You can not very well get a patient to drink a gallon of fluid a day, but you can get a gallon in through the Rehfuss tube. You can easily get them to take a quart once a day, or even two quarts.

A patient whom I had to show you at Michael Reese hospital this morning is one of the ones who drinks his three quarts a day. The process does not seem to be as effective when they drink the water as when it is taken through the duodenum. Whether it is changed by the acids of the stomach, or partly by absorption while in the stomach, I do not know.

DISCUSSION

Dr. A. E. Halstead: In a large percentage of the cases of gangrene of the foot (Schede places it at 70 per cent) occurring in diabetes, the onset of the gangrene is determined by an obstruction that is located at the bifurcation of the popliteal artery. This obstruction is due to an obliterating endarteritis. If in a given case the gangrene has reached the dorsum of the foot, and there is no pulsation in the posterior tibial artery, we are justified in assuming that the obstruction is in the popliteal artery. In these cases, the method of treatment recommended by the essayist could be of little avail in effecting a cure or in delaying the process. Under these circumstances an amputation is the only remedy.

Dr. Sullivan: On the subject of drinking water, I might say that one time I suffered with peritonitis, and after the first part of the attack was under control I had no trouble in drinking one gallon of water a day, and I kept that up for over a week, by using plain water, like some water without minerals. After trying a lot of waters I finally asked for Waukesha water, and then a gallon a day was a scant amount, and after a while I wanted more; no inconvenience whatever.

I have tried that on patients very often. Take peritonitis following a case of appendicitis, where they want to eliminate, and give them Waukesha water, and they will drink it without any complaint. There seems to be a difference between water of that kind and lake water. I remember when I was a boy we used to try a trick of drinking water to see who could drink the most, and from certain wells or springs we found we could drink the water much more readily than from others. So probably you can get your patient, if you have a drinkable water that absorbs readily, to drink a gallon a day without trouble.

A CASE OF TUBERCULOSIS OF THE KIDNEY

Dr. Hugh N. MacKechnie: W. R. H., age 37, came to my office October 17, 1910, complaining of first severe hæmaturia—clots and fluid, one-half quantity passed being blood; second, sensation once or oftener a day of something passing down the left groin from the lumbar to the pelvic region with feelings of uneasiness and desire to urinate followed shortly by urination of bloody urine. At no time did these sensations constitute a pain, although there were occasions when they were markedly severe; third, loss of ambition, appetite, strength and weight; fourth, headache as of a binding sensation around the head, accompanied by a feeling of emptiness and dizziness with ringing in the ears.

The father died at the age of 38, of bowel trouble contracted during the war. The history pointed to a tubercular condition in both the abdomen and the chest but the patient is not clear on this point. The mother, aged 52, is living and well. The patient has no brothers. One sister is living and in excellent health. No man in his father's family as far as known has lived to be forty years old.

The patient has had the diseases of infancy; no specific history. He has almost always been healthy except for the attacks of hæmaturia; he smokes regularly 3 to 6 cigars daily. He drinks occasionally but never to excess. At the age of seventeen he had an attack of typhoid fever with a severe relapse. Following this for ten years he had a semiannual attack of chills and fever and malaise; then instead of the usual attack he had one of hæmaturia. For the succeeding ten years he had a semi-annual attack of hæmaturia, varying in severity and lasting from one to three weeks. During this period he has had treatment of various sorts, hygienic and medicinal, with little or no results. The results secured seemed to be coincident with rather than due to the use of any special treatment. The bleeding would commence suddenly without apparent cause

or warning and end as abruptly. Rest in bed or exercise had no apparent effect. The loss of weight and strength was usually not so marked as in the present attack.

The patient is well nourished, and muscular; height 5 feet 7 inches, present weight 130 pounds, although he has recently lost 25 pounds. The skin and mucous membrane are pale. He has an anxious expression. Temperature 99 to 99.2°; pulse 90 to 100; blood pressure 120 systolic. The lungs are normal; there are no enlarged cervical or supraclavicular glands; there is a hæmic murmur at the base of the heart. There is no point of tenderness over either the bladder or kidneys; neither kidney is enlarged.

When shaken the urine appears to be almost all blood. After standing, about half the quantity is sediment. Microscopically no tubercle bacilli are found on careful examination of several stained slides of sediment. There are present many blood cells, a few pus cells; and a few organisms resembling the colon bacillus. Chemical examination of the urine is unsatisfactory. On October 31, 1910, fifteen cubic centimeters of washed sediment were injected into the peritoneal cavity of a guinea pig. A month later, on December 1, two weeks after operation, the guinea pig was killed and postmortem examination showed tuberculosis of the internal viscera, viz: the liver, spleen and mesenteric glands (Chicago Laboratory).

On November 5, 1910, a cystoscopic examination was made and the ureters were catheterized. Normal urine was passing from the right ureter, and bloody urine from the left ureter. The ureteral orifices were normal except for slight redness below the left. No tubercles were present and the bladder was normal in appearance. Two specimens were secured from the left ureter; one plain bloody urine, the second urine with boric acid solution which had been used to clear the ureteral catheter of clots. No specimen was obtained from the right ureter because of tenesmus. The pelvis of the kidney was flushed with adrenalin chloride solution. A weak solution of silver nitrate ½ per cent was instilled and as much as possible left when the catheter was withdrawn. This had but a temporary effect, the bleeding being as bad as ever on the succeeding day. Both specimens were examined in smears and culturally. No tubercle bacilli were found on careful examination of several stained slides of sediment. There were present many blood cells, a few pus cells, and a few organisms resembling the colon bacillus. The Widal test was negative; von Pirquet gave slight reaction.

At this stage a diagnosis of hæmaturia, probably tubercular in origin, was made and on account of the severity of the bleeding an operation, either nephrotomy or nephrectomy, was advised but was refused. The patient preferred to try continued medication with rest. This included the use of gelatin, calcium chloride, ergot, adrenalin and later a vaccine.

Dr. Frank Billings after consultation stated: "On November 9, 1910, Mr. R. H. was brought to me by his physician, Dr. Hugh N. MacKechnie. The patient, a well nourished man of 37 years, suffered from hæmaturia which had persisted for seven weeks. He also gave a history of previous attacks of hæmaturia lasting for three or four weeks beginning and stopping suddenly. This phenomena had occurred every year for ten years. There was no other complaint except that of the loss of strength and endurance due to the loss of blood.

"The examination showed a patient very pale but well nourished as to fat and muscle. There was no tenderness to be elicited over either kidney and no tumor to be felt. A hæmic murmur was heard at the base of the heart at the left second costal space. The urine contained blood with free red cells in large amount. The anæmia was severe, the hæmoglobin 32 per cent (Sahli); reds 2,164,000, whites 6,500.

"Dr. MacKechnie was advised to have cultures of the urine made, to put the patient at rest in bed with the surface of the body warm; if positive cultures were obtained to vaccinate the patient with the autogenous vaccine; if hæmorrhage continued and was severe, to repeat the cystoscopic examination, already made and if necessary to perform nephrotomy or even nephrectomy."

The culture was made by Dr. E. C. Rosenow from a mixed specimen of urine. His report is as follows:

"Cultures on ordinary media from a contrifuged specimen of urine failed to show any growth in spite of the fact that smears from the sediment showed rather numerous Gram negative bacilli. But cultures on blood agar plates showed numerous small colonies which produced no change in the blood and which grew on the surface of blood agar slants but not on plain agar. Smears showed a moderate sized bipolar staining slightly motile Gram negative bacillus from which a vaccine was prepared. The growth was washed off in sodium chloride solution and sterilized at 52° C. for two hours. The tubes of vaccine which I sent you contained 100,150,200 and 300 million bacilli respectively, and were to be injected in the order named five days apart.

"The urinalysis outside of the large amount of blood and the bacilli showed nothing of importance."

The patient entered St. Lukes Hospital November 13, 1910, and was put to bed. Temperature 99°, pulse 92, respiration 24. He was given 10 grains of calcium chloride every two hours.

On November 14, at 4:30 p. m. he was given 100,000,000 bacterial vaccine as above, from which no reaction was seen. On November 17, at 11 a. m. he was given 300,000,000 bacterial vaccine without reaction and without an apparent effect on the hæmorrhage. At 9 a. m. his temperature was 98°, pulse 92, respiration 20; 6 p. m. a temperature 99°, pulse 102, respiration 20. On November 18, the patient was given Inf. Eucalyptus.

During this treatment there were no signs of

improvement in the hæmorrhage, the vaccine had produced no reaction and the patient gradually lost ground.

On November 20, blood examination showed hæmoglobin 30 per cent, red blood cells 2,400,000, white blood cells 5,800. Urine examination showed no sugar, no casts, blood in quantity, and a few pus cells. Operation was again proposed and accepted.

On November 21, the patient was given first 700 cubic centimeters of saline solution intravenously, and was operated upon under nitrous oxide ether anæsthesia, neither of which was well taken. A diagonal lumbar incision was made on left side to expose the kidney which, on account of firm adhesions, was with difficulty brought into the wound. The capsule was split and readily stripped off. On the convex surface was seen a dark foggy mass which was cut through, and a small amount of dark blood ran out. The kidney was cut from pole to pole through the convex surface to the pelvis. On the cut surfaces were seen the small concretions shown in the specimen. A careful examination of the pelvis revealed no special ulcerated bleeding point which might be ligated, and it was decided to do an excision. A ligature was applied to the stump, but it slipped off and considerable hæmorrhage ensued. The bleeding points were rapidly clamped and these clamps were left on for two days. Three silkworm-gut sutures for coapting muscles and skin were inserted. Dressings were applied and the patient was removed to his room. The pulse was 112 and of fair quality. The patient was given strychnine sulphate 1-30 grains every four hours, normal salt solution high per rectum, continuously, and liquids by mouth. Morphine sulphate was given (⅛ grain) if required, for restlessness.

On November 22, morning temperature was 99.8°, pulse 94. The patient passed a comfortable night. During the day the pulse and temperature rose. At 7 p. m. temperature was 103°, pulse 112, and of a fair quality.

Urine examination 55 ounces; specific gravity 1,017; albumin; acid; blood present and pus absent. The urine was brownish red with red brown amorphous urates, no casts.

During the night of November 23, the temperature and pulse rose and the patient grew worse. He was given 500 cubic centimeters of normal salt solution intravenously at 6. a. m. with slight temporary improvement. At 8 a. m. the temperature was 105°, pulse 142, respiration 36. Diaphoresis was profuse. The hands and feet were cold. The patient was in a stupor from which he could be roused with difficulty. The ocular reflexes were lost and the pupils dilated. Cheyne-Stokes respiration for some four hours. The patient was given 900 cubic centimeters of normal salt solution intravenously, with no apparent effect. The blood which escaped did not clot. At 12.30 a direct transfusion of blood was given, using the Crile tube. Within a half hour the patient opened his eyes and recognized his nurse but

Fig. 1. Specimen Dr. Lounsbury's case of tuberculosis of kidney.

sank into a stupor. At 2 p. m. he was again conscious and asked for lemonade. The pulse gradually came down and at 5 p. m. his temperature was 100°, pulse 108, respiration 36. The next morning the urine which had been almost clear, became bright cherry red in color. A few blood cells were present, much hæmatin. This condition was evidently due to hæmolysis following the transfusion, and it cleared up during the day.

From this on the patient made an uneventful recovery leaving the hospital December 23, 1910. at which time the blood examination showed hæmoglobin 40 per cent, red blood cells, 2,765,000; blood pressure, systolic 115.

There was a sinus, tubercular in appearance, which persisted seven weeks. The pathologic report on the kidney was made by Dr. E. R. Le Count (See Figs. 1, 2, 3):

"The kidney is slightly smaller than normal. It is smooth externally except for one region to be described presently and the capsule strips easily. Opposite the middle of the kidney on the posterior surface there is a depressed region which extends from the hilum nearly to the outer convex border. This region is 2.5 centimeters long and 1 centimeter wide. In its deeper parts the cortex is entirely absent. On the outside of the kidney, this region is red and its margins are beset with fine gray elevations not unlike miliary tubercles in size and other features. Directly beneath this depression there is a cavity in the cortex formed by the enlargement of one of the calyces. This cavity has an average diameter of 1 centimeter. The lining is brown, and there are scattered white gritty masses deposited on the lining here and there. The renal tissue surrounding this region has lost its normal appearance, there are no striations of either cortex or pyramid seen upon the surfaces made by sectioning, and the junction of the cortex and pyramid is not clearly defined. Externally this region in the kidney looks like an infarct in some stage of healing and the alterations in the renal tissue about the cavity also indicate some degree of chronicity. The lining of the cavity (or dilated calyx) is beset with minute pin-head sized elevations.

Fig. 2. Section of kidney, Dr. Lounsbury's case.

Fig. 3. Dr. Lounsbury's case of tuberculosis of kidney.

"In a calyx in the upper pole of the kidney there are similar changes. Here the chief alteration is an absence of the tip of one of the medullary pyramids. On the surfaces made by sectioning this pyramid at right angles to its longest axis this defect extends proximally with reference to the circulation of the urine to a point midway between the base and the tip of the pyramid, that is, the necrosis extending outward from the calyx and the lining of this accessory cavity is like that of the other cavity, brownish and finely granular. Similar but even less marked changes are present in one or two other calyces. The lining of the renal pelvis is smooth and unchanged. The cortex measures from 3 millimeters to 6 millimeters in thickness. There are no other gross lesions in the kidney.

"Microscopical examination. The usual features of a tuberculosis of the mucous membrane lining the renal pelvis and calyces are met with in sections prepared for microscopical examination. From the surface toward the more normal tissue there are met with a zone of necrosis which varies slightly, a layer of granulation tissue which is very poor in blood-vessels and where these two meet the nuclei of the cells are arranged at right angles to the surface and parallel to one another in a manner quite characteristic of tuberculous lesions in this location. Giant cells are infrequent."

On December 28 we began the use of tuberculin O. T. 1:10,000 milligrams. The patient had a severe chill, his temperature rose to 104°, and he was markedly prostrated. It took several days for him to recover. On January 8, 1911, the patient left for the south. He returned a month later much improved. On February 6, 1:10,000 milligrams O. T. produced a mild reaction with malaise and uneasiness, no chill; no rise in temperature, no increased pulse rate. This dose was repeated six times and then gradually increased. He was given treatment several months and improved rapidly.

In 1915 the patient complained of trouble in the dorsal region at the seventh vertebra. As this increased, deformity set in. Roentgenography revealed a tuberculous necrosis of the body of the seventh vertebra, and involvement of the intervertebral disks above and below. I performed an Albee operation from which he recovered nicely. His deformity has not increased and his pain has ceased except at the upper end of the transplant where only fibrous union has taken place.

On March 1, 1919 the patient returned for examination. He appears to be well nourished, looks well, and weighs 145 pounds. His spine shows some deformity but there appears to be no active process present. The lungs are clear, the heart good, the abdomen negative, and the kidney functional test normal. Urine specific gravity 10.05, clear, acid, urea 0.2 per cent; albumin trace; no sugar, no casts, pus rare. Cystoscopy showed the left ureteral opening contracted. There were no tubercles, but an old healed ulcer on the trigone. The right ureteral opening was normal. Urine came from it regularly. Animal inoculation was negative.

Of the presenting symptoms in renal tuberculosis, cystitis with an irritable bladder and painful urination comes first in frequency. The patient reports a burning in the bladder which is found not to yield to ordinary treatment. Crabtree and Cabot[1] say the bladder symptoms are first in 48.5 per cent of cases, renal pain is next in 35.7 per cent of cases, hæmaturia in 4 per cent. McKenzie[2] reporting the work at the Royal Victoria Hospital in Montreal, gives cystitis as the first and foremost symptom, then hæmaturia in 15 per cent of cases, pain over the kidney in 12 per cent. Constitutional symptoms of chills, fever, night sweats, and loss of weight are seldom present. Tubercle bacillus was found in 80 to 90 per cent of cases. The only indicating symptom in this case is the hæmaturia, which was very marked. The sediment was about half the quantity passed. Examination revealed slight urinary changes with pus casts and albumin. Even cystoscopy showed the ureteral orifices and bladder without tubercules after so many years' duration. Its mode of onset and cessation is similar to that of other reported cases, but the duration of attacks and of years during which they occurred are more than I have seen recorded. It is the type of case that has been often classed as essential hæmaturia. Lyons[3] cites one case in which hæmaturia was the only symptom. It first appears in 1908, returned in the spring of 1913 and again in the fall of 1913 when it lasted seven weeks. He states that an early symptom is a polyuria. Unfortunately these symptoms of irritable bladder and polyuria appear to be of such minor importance

[1] Crabtree and Cabot. Surg., Gynec. & Obst., 1916, xxiii, 495.
[2] McKenzie. Canad. M. Ass. J., 1918.
[3] Lyons. Colo. Med. 1913, May.

that out patients either doubt the possibility of our suspicion, or will not accept the expense of further examination and investigation, or the necessity is not impressed on them. Not until the case has well advanced do they reach the surgeon or urologist with an intense desire to get relief. Every case that presents a slight amount of pus should be thoroughly examined for a possible latent tuberculosis for many of these cases pass the stage of assistance because of the lack of pronounced symptoms. Bugbee[1] reports a case with no symptoms. Tubercle bacilli were found by chance in making a complete physical examination. The bladder and ureters were normal. The quantity of urine from the left kidney was double in amount that from the right; it was pale, and there were found albumin, pus and blood. The urea output was low. Tubercle bacilli were present. Five years later a nephrectomy was performed at the time the patient was operated upon for costovertebral pain and gastro-intestinal symptoms. The kidney was found to be enlarged and it had numerous walled-off pockets containing a thin serous fluid.

The duration of development in the case reported is quite striking. At the age of seventeen years the patient had his first attack of chills and fever of a mild indefinite type. These attacks came on each spring and fall, lasted for a few days and passed off leaving him apparently as well as before. Should these attacks be regarded as the result of early focal infection or as the breaking down with absorption of a necrotic mass? From the gross pathology either might be a natural conclusion for besides the areas of recent ulceration we have small areas showing some evidences of fibrosis and incrustation with urinary salts. It is unusual to find these cases running such a prolonged course. This patient did so because his lesions were all small and became encapsulated and quiescent. He would not in earlier years accept a thorough examination for diagnosis maintaining that each attack was similar to, and would end as had previous attacks. I know that because five years before he became my patient I saw a specimen of his urine and urged his physician to bring him to further investigation but this could not be done. This gives him a developmental period of twenty years and a post operative period of eight years and four months. On the other hand Pousson[2] reports a case in which there were no symptoms for eighteen years but returned. Crabtree and Cabot report the following cases well after operation, and one in 18 years one in 15, one in 13, two in 11, one in 10 years. The longest period of development of symptoms for any case in their series was 10 years.

This brings up the question of a cure and what it constitutes. Shall cure be judged by a clinical or pathological standard or both? Naturally human patients cannot be sacrificed as animals can to ascertain their condition. Only in so far as we find these kidneys at operation or at autopsy can we arrive at conclusions.

Dock[3] says: "I have not a full analysis of all the cases but the total impression one gathers is that true healing of renal tuberculosis is rare, that it has lesions little susceptible to healing under general treatment, but has a strong tendency to complete destruction of the kidney; in which, however, the disease may be shut in for a time with constant danger, of local or general tuberculosis at all times. Heitz Boyer[4] reports a case supposed to have been cured. Twelve years later the patient had a swelling in her loin but as she had no physician she had gone without a diagnosis. Eight years later she had a nephrectomy and there was found an enlarged caseous kidney in which the renal tissue was wholly destroyed.

Keyes reports a case which had a nephrotomy done by McBurney in 1895. Seventeen years later the patient died of carcinoma of the gall-bladder and liver. Autopsy showed the kidney entirely destroyed by a tuberculosis which had been progressive probably from the time of the nephrotomy.

Zukerkandl[5] says induration of a tubercular kidney and hardening of the parenchyma may be taken as a local recovery but never absolute.

We are therefore led to accept our clinical signs and symptoms as proof only of probable recovery with a certain reservation prompted by operative and autopsy experience. We are further confirmed in our reservation by our belief that tuberculosis of the kidney is always secondary in origin and that its route of arriving at the kidney is hæmatogenous. It does, however, tend to focus in the kidney as its early metastasis as shown by Baumgarten in his experimental and postmotem work. If tuberculosis is found in one kidney we have every reason to suspect that it is, or will eventually be in the other, unless we eliminate the primary focus. On the other hand it may be clinically shown to be absent from the second.

We are therefore bound to accept as evidence of probable recovery those cases that are improved symptomatically knowing full well that in any one case the absence of symptoms may be due to a fibrosis or to the encapsulating of a caseous focus that will break down or ulcerate at any time. On the other hand we must remember that the condition may be unilateral and that nephrectomy may remove the only active focus in the body.

The treatment of these cases is without doubt surgical, i. e. nephrectomy. This is the only means of removing a focus which may be producing a general infection. The time for operation may be a matter for consideration but seldom calls for delay further than to ascertain the status of the opposite kidney. We should not temporize with tuberculin in the hope of producing a degree of immunity. If such may be produced at all it has

[1] Bugbee. Surg., Gynec. & Obst., 1918, xxvi, 479.
[2] Pousson. Assoc. d'urol., Paris, 1912.
[3] Dock. Am. Urol. Ass., 1916.
[4] Heitz Boyer. J. d' urol., 1912.
[5] Zukerkandl. Urologie, 1902.

been done by the infection present. If this does not do it surely no heterogeneous material will do so.

What if any value can be gotten from a nephrectomy in a hæmatogenous infection. Balfour states that 80 per cent of cases are lateral at operation but that 75 per cent are bilateral at autopsy. Israel[1] has shown that the infection locates in one kidney first and later in the second and that this second infection is not from the first kidney but from the extra renal primary focus. In other words, if we take these cases early and perform a nephrectomy we have some prospect of checking the disease, provided its primary focus is in some organ susceptible of healing, and not in the opposite kidney, which is not so susceptible.

Kapsammer[2] gives more conservative figures and says that in 191 cases 67 (35 per cent) are unilateral and 124 (65 per cent) bilateral.

Lower[3] says: "Our impression from symptoms and findings in diagnosis is that early and sometimes late renal tuberculosis is unilateral at the time of operation, but on the other hand autopsy records show that about two-thirds of cases are bilateral."

In other words tuberculosis of the kidney is generally unilateral early but if allowed to run its course almost inevitably becomes bilateral. It would seem that the case reported was an evidence that it may be unilateral, for at the end of eight years and four months we have at least no clinical evidence that the other kidney is involved even in the face of the fact that since the first operation we have had an active process in the spine.

After operation the usual hygienic treatment should be persisted in, supplemented by the use of tuberculin. The value of the latter is questioned by many and perhaps rightly so in renal tuberculosis. Walker[4] says tuberculosis relieves symptoms but does not cure. Wildbolz[5] used tuberculin for from 2 to 12 months in these cases and reports general improvement but no healing of the kidney was seen.

On the other hand if the active renal focus is removed the extra strain is taken off the patient, the resisting powers are permitted to work on the primary focus and a cure may be expected as in any tuberculosis.

CONCLUSIONS

1. Tuberculosis of the kidney is probably primarily unilateral but if allowed to persist may become bilateral, either from infection from the first kidney or from the primary focus.

2. Tuberculosis of the kidney may persist for many years without bladder involvement or other evidence to attract our attention. A mild persistent cystitis should arouse our suspicion.

3. Early excision is called for and subsequent treatment as for tuberulosis at any point, dietetic, hygienic, tuberculin.

4. We have no antemortem positive proof of a cure. Our only evidence is the absence of symptoms after a reasonable length of time, and this postmortem experience makes us doubt.

[1] Israel. Folia Urol., Vol. vi.,
[2] Kapsammer. Am. J. Urol. 1913.
[3] Lower. Tr. Am. Urol. Ass., 1916.
[4] Walker Practioner, 1908.
[5] Wildbolz. Wien. med. Wchnschr., 1911.

AMERICAN COLLEGE OF SURGEONS

CONCERNING HOSPITAL STANDARDIZATION

TO define hospital standardization in a negative way, it is not an effort to make hospitals alike in form of government, of administration, or of equipment; it does not seek to enforce conformity to any given mold nor to limit originality in any phase of hospital work.

Hospital standardization means *thinking alike* on the part of doctors, hospital trustees, hospital superintendents, laboratory workers, nurses, and the public upon the aims and utility of hospitals. It means that every patient in a hospital is entitled to the most efficient care known to the medical profession; and that every hospital believes itself morally obligated either to render such service to its patients or to state frankly to the patients that it cannot do so.

The entire program of hospital standardization undertaken by the College is a gift to hospitals and to the medical profession. But in so far as any such program is one of reform, that program may or may not in a true sense be a gift. In what way, then, is the effort of the College a gift? This question is important. The answer to it lies in the method itself with which the College has taken up the work.

There are two methods by which hospital standardization may proceed. The first is scientific; the second, human. These methods are not entirely exclusive, one from the other, but the difference between them is, nevertheless, the difference between a gift of lasting worth as against an uninvited interference of doubtful value.

The scientific method is concerned with its own point of view. It is interested in the outcome of its actions on others. It assumes that men and institutions are to be governed and that, having determined upon a *best* form of government, there is no right of appeal by the governed. Under the scientific method hospital standardization would say to the hospitals: "I have analyzed correctly my own duty toward you and you must therefore accept all that I do to you. You may not like it. Here is a plan for the betterment of hospital service. You must co-operate by accepting it. It will do you good."

The scientific method has wrecked many a worthy project of reform. It prejudices men against all systematic progress. It is a prevailing foolishness among us which keeps the millennium undated. It is a blunder which the College in its relations with hospitals and the medical profession resolutely determined not to make.

The human method never forgets the point of view of others. In fact, that is the only point of view which it knows. It assumes that men are intelligent and open-minded. But it is not sentimental or merely "sugar and spice and everything nice." It values straight thinking and accurate data quite as much as does the scientific method. Under the human method hospital standardization says to hospitals: "Here is a plan for the betterment of hospital service. It is a plan which grew out of our own heads and hearts after conscientious and long effort on the part of all of us to devise such a plan. Will you please consider whether or not you will accept it? Will you become a rival for the light under the terms of this plan?" This is the method with which the College took up hospital standardization.

That some concerted action for the betterment of the practice of medicine is needed, no one questions. The opportunity to be a part of such action faces each of us. Five years ago the field of hospital standardization, as a means to this end, was unoccupied When the College entered the field at that time, it did so with exceeding care, for it had no precedent

to guide it and it had also to provide itself with the necessary personnel, office machinery, and financial support to carry the work.

What Has the College Done?

At the beginning of the College in 1913 active work in hospital standardization was accepted by the College as the most practical means to advance the art and science of surgery, for if surgery is to be advanced, the conditions surrounding the practice of surgery must be correspondingly improved. The following paragraphs state briefly what has been done toward standardization of hospitals since that date.

In 1914, in connection with the necessary work of perfecting the organization of the College and of obtaining a sound financial basis, the College began to acquire first-hand information about hospital conditions in Canada and the United States. It conferred with doctors, hospital trustees, and hospital superintendents about the work; with medical societies and with hospital organizations, asking their help and co-operation in formulating a plan of action.

In October, 1916, at the annual meeting of the Fellows in Philadelphia, a report of these informal conferences was made. Further, at that meeting the Fellows were asked to create in each province in Canada and in each state in the Union a standards committee, the purpose of the committees being to advise with regard to a sound and constructive program of action. Promptly after that meeting, in accordance with the vote of the Fellows, these standards committees were elected by ballot.

For reasons of the war, these committees were not called together until October, 1917. At that time they were called into session in Chicago, about three hundred and thirty being present. About fifty leading hospital superintendents were also, on invitation, present at the meeting. For two days these committees with their guests considered three fundamental questions which were: What conditions exist in hospitals? What do we want in hospitals? What is to be done? This meeting clarified many hazy problems. A full report of the meeting (Bulletin No. 1, Volume III) was printed and distributed to the hospitals and to the Fellows. The immediate outcome of the meeting was the appointment of a committee of twenty-one, upon which were represented physicians, surgeons, hospital administrators, laboratory workers, statisticians, etc., the purpose being to outline a questionnaire through which the College might obtain hospital data essential in its further work and to consider a "minimum standard of efficiency."

The committee of twenty-one met for two days in Washington, in December, 1917, formulated the questionnaire, and discussed, the "minimum standard." Early in 1918 the questionnaire was sent to the hospitals, together with a letter asking the co-operation of the hospitals in the standardization program. The response of the hospitals to this questionnaire exceeded the most optimistic hope of those concerned with the work. Hundreds of letters came from all parts of the continent, pledging co-operation. As a matter of information the questionnaire was sent also to the Fellows. In March, 1918, a complete statement of the hospital standardization program of the College and of the minimum standard was sent to the hospitals and to the Fellows. This statement is Bulletin No. 3, Volume III, now out of print.

The conferences above referred to all emphasized the need of personal investigations of hospitals. In March, 1918, the work of personal investigations of hospitals was taken up. The College employed visitors or inspectors to make reports of conditions at the various hospitals. An important part of the work of the visitors was also to explain the details of the program more fully than can be done by pamphlets or letters, and to make clear the spirit of all of the undertaking.

At this time about 700 hospitals have been visited by staff members of the College. The reports of the visitors, together with the action taken, are recorded upon cards printed for the purpose, and are specific as to the following "minimum standard":

Staff Organization. Extent of analysis or review of professional work; regularity of meetings; reorganizations contemplated; evidences of staff-team work, group discussion and interest in scientific work, research, education of internes, etc.

Case Records. Data as to medical, surgical and obstetrical case records of all classes of patients

treated in the hospital; methods of recording, classifying, filing, etc; contemplated changes.

CLINICAL LABORATORIES. Equipment of the laboratories; number and training of the laboratory workers and technicians; extent to which adequate laboratory service is provided; supervision given internes doing laboratory work.

A letter to the superintendent precedes these visits, outlining its object and stating the approximate date of visit. The visitors, of course, seek first of all the assistance of the superintendents in this work. And before each visit ends, the entire standardization program usually finds its way to the local Fellows, internists, staff groups, and members of the board of trustees. The frankness of all concerned with the hospitals in stating their problems and their willingness to consider these problems with the visitors of the College are a constant encouragement.

The following is one of the many reports made for the College by Mr. Frank E. Chapman, this report being an addition to the regular report on the minimum standard:

The X-Ray equipment is very complete with an exceptionally bright and intelligent technician on duty at all times. Volume of work is not large but the character is very good. Do not believe it is being used as much as it should be. The hospital has a technican in charge of the laboratory. Not equipped to do Wassermanns; from the conversation I had with the technician, I do not think she is equipped to do laboratory work of any kind. There is no such thing as routine laboratory work. Very little pathology is done and that only when special charges are made.

The deplorable thing about the hospital is the general atmosphere of the place. It is a business proposition from start to finish. Pupil nurses are permitted to do special duty work even in the first year of their training for which the hospital charges and collects the fee. This institution is operated in conjunction with two other hospitals of the state, all of which are on a par.

Again, the following, somewhat condensed, is a report made by Miss Anna C. Phillips:

CAPACITY. 150 beds. Private charitable institution.

TYPE. Medical, surgical, obstetrical.

STAFF ORGANIZATION: A loosely organized group. Regular meetings not held. Any physician in good standing may bring patients to wards or rooms. No regulations. Number internes, three. Number pupil nurses, seventy-two.

LABORATORIES. Well equipped, clean, light, laboratories in charge of part-time, trained workers. Pathological laboratory under-staffed and internes do laboratory work without supervision. No laboratory records kept which would indicate volume of work.

SUPPLEMENTARY REPORT. Hospital located in quiet residential section; car line near. New fireproof building surrounding three sides of large open court gay with flowers, shrubs, etc. The low broad lines, balconies facing the court, and the general impression of brightness and comfort, reflect definite planning and thought. Atmosphere dignified and prosperous. A sense of confusion in the wards is probably due to the numbers of doctors attending and the varieties of treatments ordered for the same types of cases. Staff has been dissatisfied with existing organization, but has found difficulty in inducing the trustees to assume responsibility regarding establishment of definite rules and regulations. The teaching in the local medical school is not strengthened by the standards existing in this hospital. Duplicate report left with chief of staff for presentation to Board.

During the current year a full report of the results of these visits will be made by the College and classifications of the hospitals of one hundred beds or over will be published in accordance with the findings of the visitors. As stated in Bulletin No. 3, Volume III, the College will not include any hospital upon an accredited list which permits the practice of the division of fees to exist among the physicians and surgeons caring for patients in the hospital. For the convenience of governing boards of hospitals in expressing their policy, the following resolution is suggested:

WHEREAS, the practice known as the division of fees is unworthy and destructive to the best interest of patients and, whereas, the medical profession is unqualifiedly opposed to this practice in any guise whatever, therefore,

BE IT RESOLVED that no physician or surgeon who engages in the division of fees may hold the privileges of practice in.....hospital, and further,

BE IT RESOLVED that a copy of this resolution be sent to each physician and surgeon who now avails himself of the privileges of practice in..... hospital, and that further practice in the said hospital on the part of these physicians and surgeons be interpreted as acceptance in good faith of the foregoing resolutions.

In January, 1919, the College published a bulletin, Volume IV, No. 1, entitled, "Case Records and Their Use." This bulletin reviews the program of hospital standardization and explains in much detail what adequate case records are and what their value is in hos-

pital service. Forty thousand copies of this bulletin have been distributed to doctors, hospital trustees, hospital superintendents, etc.

In January, 1919, the College published also a bulletin, Volume IV, No. 2, in which an actual set of case record forms was suggested. The purpose was "to prepare record forms which are simple, convenient, and adequate to meet the needs of record keeping in cases usually found in general hospitals." Forty thousand copies of this bulletin were distributed.

In the matter of keeping adequate case records among hospitals, the requirements for admission to Fellowship in the College have proved of practical help. Candidates for admission to Fellowship are requested to submit to the College one hundred case records, fifty in abstract and fifty in complete detail. These records, if they are to be approved by the College, must indicate intelligent and thorough study and treatment of the cases concerned. A hospital in which a candidate for Fellowship prepares these records, if not already keeping adequate records, is usually induced to do so.

Early in 1918, as soon as the program of the College was made clear, requests came from hospitals and doctors that the public be informed of the work. Much effort has been made to meet this demand. In more than forty cities hospital standardization conferences have been held during the past year. In this way the program of the College has been carried not only to the medical profession and to hospitals, but also to business men's associations, chambers of commerce, women's clubs, etc. The following program held in April, 1919, in Portland, Oregon, is typical:

PROGRAM

Luncheon, Chamber of Commerce, 12:15 p. m.

MR. A. L. MILLS, Presiding.

Fifteen Minute Talk . . . . . DR. JOHN G. BOWMAN
Fifteen Minute Talk . . CHARLES B. MOULINIER, S. J.

AFTERNOON SESSION, 2:00 O'CLOCK

Lincoln High School

The Occasion for the Conference . . . . . DR. KENNETH A. J. MACKENZIE
Chairman, State Committee on Standards

What is Hospital Standardization? (Clinical Laboratories, Case Records, Staff Organization.)
DR. JOHN G. BOWMAN, Director of College

Discussion:

(a)	Clinical Laboratories	DR. A. E. MACKAY MAJOR R. L. BENSON
(b)	Case Records	MAJOR R. C. MATSON, MAJOR WM. S. KNOX
(c)	Staff Organization	DR. S. E. JOSEPHI DR. E. F. TUCKER

Summary CHARLES B. MOULINIER, S. J.
President, Catholic Hospital Association

Following such meetings many hospitals take immediate action to meet the minimum standard of the College. Sometimes a special meeting of the local county or city medical society is called with the object of bringing about hospital standardization for all of the hospitals in the vicinity at the same time. An outgrowth of a number of such meetings has been the organization of a central clinical laboratory to serve all of the hospitals.

The co-operation of the Catholic Hospital Association with the College is encouraging. The Association officially endorsed the program of the College as its own program, and through the leadership of Charles B. Moulinier, S. J., President of the Association, working as a representative of the College, the Catholic hospitals are revolutionizing the character of their service to their patients.

This comprehensive survey, undertaken by the College of Surgeons, has required for its successful execution the expenditure of a considerable sum of money, an average of more than fifteen thousand dollars a year. More than thirty thousand dollars will be required for this work during the current year. The Fellows of the College have provided liberally for this and similar work by their dues and by the interest on the endowment of five hundred thousand dollars subscribed by the Fellows. A sum of thirty thousand dollars was also contributed to this special work by the Carnegie Corporation.

From beginning to end hospital standardization is the making of a reality out of an ideal. It is a high-spirited, clear-headed, dead-in-earnest effort on the part of all directly concerned with hospitals to call themselves to their own best senses. The inspiring fact about it today is that nearly all hospitals on the continent are gladly a part of the effort, lowering to their own surprise the mortality of their own good intentions.